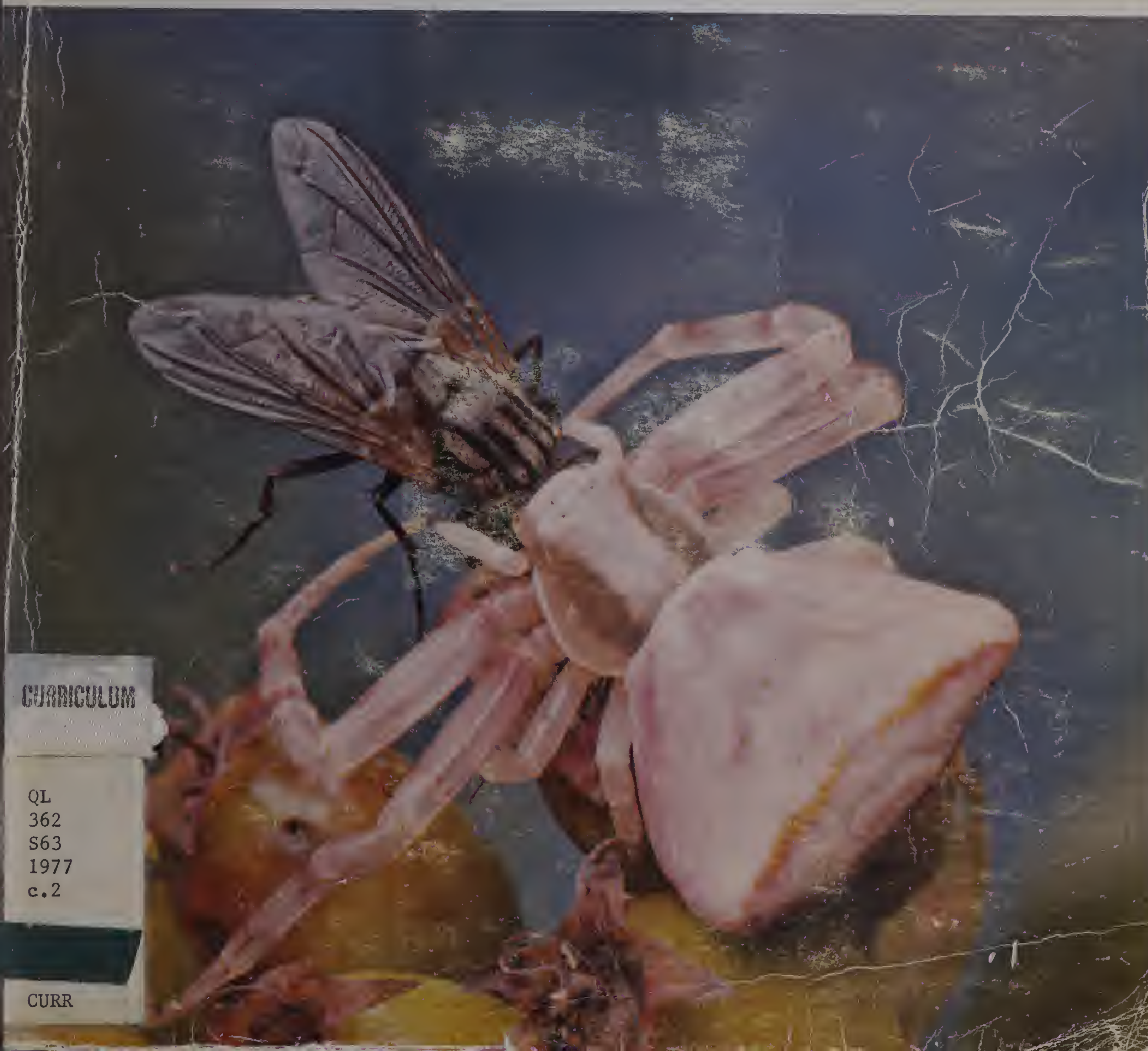
J.C. MacBean A. Stecher D.F. Wentworth

Small Creatures

Examining Your Environment



Small Creatures

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ISBN 0-03-922294-2

The Metric Commission has granted use of the National Symbol for Metric Conversion.

Printed in Canada 3 4 5 81 80 79

Contents

only if you do the activities and gather the information yourself.

If you follow the directions and record your data carefully, your answers will make sense. Later, you will decide what your data means by answering the questions in the *Digging Deeper* section.

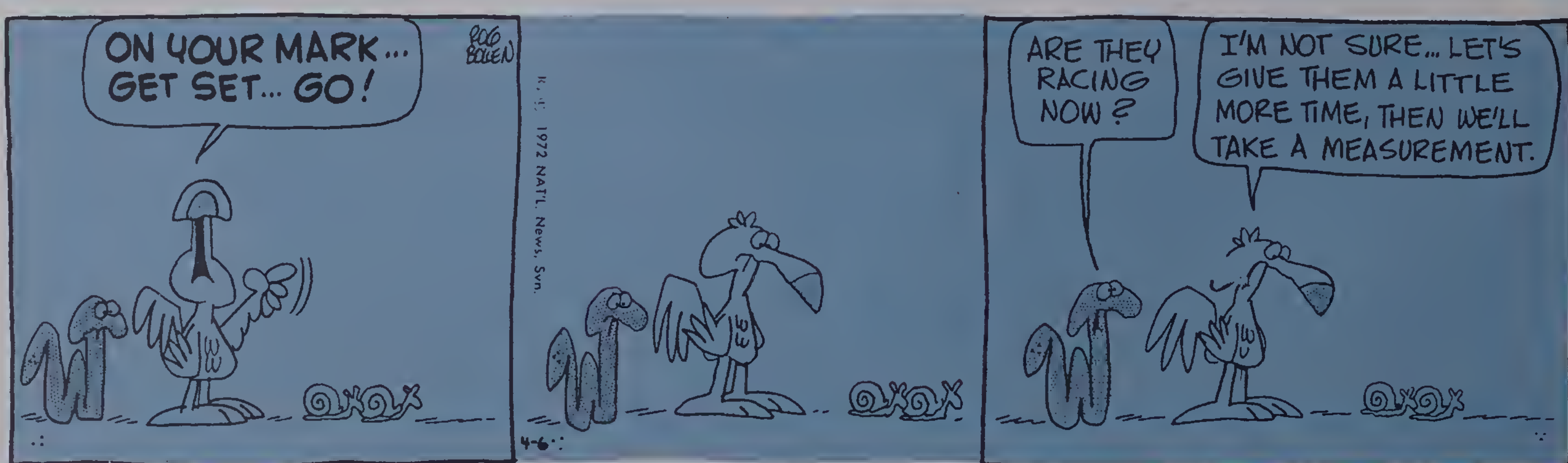
If you are particularly interested in an activity, you might wish to try the *Branching Out* suggestions. They contain more ideas for you to explore.

While you do the activities, you will also learn how to do an experiment in order to answer your questions. This book will show you scientific ways to solve interesting problems about small creatures. Once you learn these skills, you will be able to use them over and over again to answer your questions about many different topics. Of course, the more activities you do, the more skills you will develop as you learn more about small creatures.

There are six chapters in this book. The authors suggest that you do the activities in the first two chapters before you try the other chapters. The reason for this is that these two chapters will teach you important skills. The first skill is how to *classify* and *identify* small creatures, and the second is how to set up your own experiments. These skills can be used again many times in the other chapters. The last chapter, *Creatures on Display,* describes how to prepare your creatures for people to look at, just as they are prepared at the museum. This chapter should be done last. Chapters 3, 4, and 5 provide many interesting activities with different kinds of small creatures. You may try these chapters in any order. The glossary starts on page 87. This is the section which explains the meanings of new words. Whenever you meet a new word, use the glossary or a dictionary to learn its meaning.

Do not feel that you must do all the activities in this book. If one topic particularly interests you, you may wish to study it more and leave out some other topics. You may encounter problems that aren't mentioned in the book. Your problems may give you ideas for other activities that interest you. Don't be afraid to try ideas of your own.

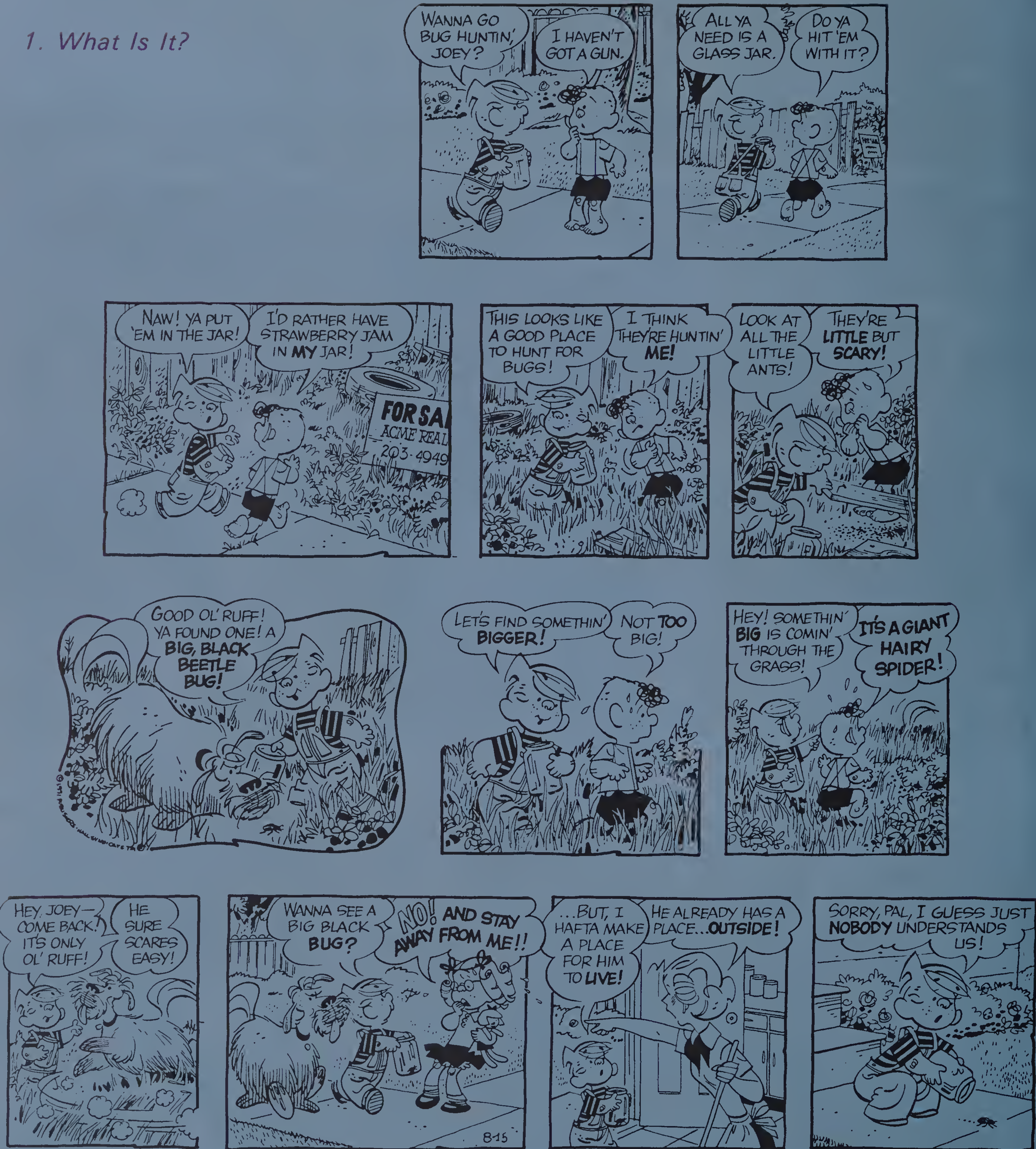
Good luck!



Dodo and his friend are having a problem with starting this snail race. What is it? How can they find out whether the race has begun? As you become involved in the activities of this book, you will use many skills. One skill is measurement.

What Is It?

1. What Is It?



WANNA GO BUG HUNTIN', JOEY?
I HAVEN'T GOT A GUN.
ALL YA NEED IS A GLASS JAR.
DO YA HIT 'EM WITH IT?
NAW! YA PUT 'EM IN THE JAR!
I'D RATHER HAVE STRAWBERRY JAM IN **MY** JAR!
FOR SA
ACME REAL
203-4949
THIS LOOKS LIKE A GOOD PLACE TO HUNT FOR BUGS!
I THINK THEY'RE HUNTIN' **ME!**
LOOK AT ALL THE LITTLE ANTS!
THEY'RE **LITTLE** BUT **SCARY!**
GOOD OL' RUFF! YA FOUND ONE! A **BIG, BLACK BEETLE BUG!**
LET'S FIND SOMETHIN' **BIGGER!**
NOT **TOO** BIG!
HEY! SOMETHIN' **BIG** IS COMIN' THROUGH THE GRASS!
IT'S A GIANT HAIRY SPIDER!
HEY, JOEY— COME BACK! IT'S ONLY OL' RUFF!
HE SURE SCARES EASY!
WANNA SEE A BIG BLACK **BUG?**
NO! AND STAY AWAY FROM ME!!
8-15
...BUT, I HAFTA MAKE A PLACE FOR HIM TO **LIVE!**
HE ALREADY HAS A PLACE...**OUTSIDE!**
SORRY, PAL, I GUESS JUST **NOBODY** UNDERSTANDS US!

Poor Dennis! Only his dog, Ruff, understands his feelings for bugs. The other people in the cartoon have feelings of fear of, or at least dislike for, small creatures. Although Dennis is sometimes a menace because of his curiosity, his experiences help him learn about the things around him. People with an attitude of fear or dislike hardly ever experience the excitement of learning as Dennis does.

If you have feelings of dislike for small creatures, try to develop some interest in them — there is such a large number of them in the world! You can use your curiosity to help you learn about many types of small creatures, including Dennis's "big black beetle bug".

No activity in this book will suggest that you handle any animal that could harm you. Your teacher will tell you what small creatures to avoid in your area.

First, try the activities with the animals with which you are most comfortable. Then you may surprise yourself by discovering that you can handle many new small creatures without fear.

Activity 1:

Where can small creatures be found?

The most important part of your equipment for this activity is your curiosity. Since you have it, let's go "bug huntin' "!

What did Dennis take with him on his search? Collect five containers. You could use empty pill vials. These are plastic containers in which pills are kept. You can get some at the drugstore. Instead, you might use empty baby food jars, plastic bags, or any other small containers. Put a piece of masking tape on each container, so that you can *label* it.

Where did Dennis go to find his "creepy crawler"? Perhaps there is a vacant lot in your neighborhood, too. If not, try a garden, a grassy lawn, a woodlot, a small stream, an open field, an old building, a basement, a garage, a fence, or the undersides of rocks and boards. There are many, many other small creatures just like the ones you can catch. But you could never catch all the creatures of any type! One of each type is enough. The one which you have captured is called a *specimen*.

How many "creepy crawlers" has your class found in your schoolyard?

What might Suzy be writing on the label?

''Look at all those legs!''

Each time you collect a specimen, write the place you found it on the tape. Try to describe the place carefully and exactly. If you found a ''creepy crawler'' on the underside of a garden plant's leaf, you might write on the tape: ''in the garden''. What would be a better label? You need to label your containers correctly in this activity, in order to do the second activity well.

When you have collected your five creatures, get together with some classmates who have also finished. Look at some of their specimens. Are they the same as yours? Or are they different? Are they too small to see clearly? You might need to obtain a hand magnifier to get a closer look. Who found the largest bug? Who found the smallest? What interesting things do you notice about the small creatures that you and your friends have found? Make a list of all the differences you notice among the creatures.

Digging Deeper

How many types of small creatures were collected by the whole class?

In how many areas did your class search?

Which area seemed to have the most small creatures?

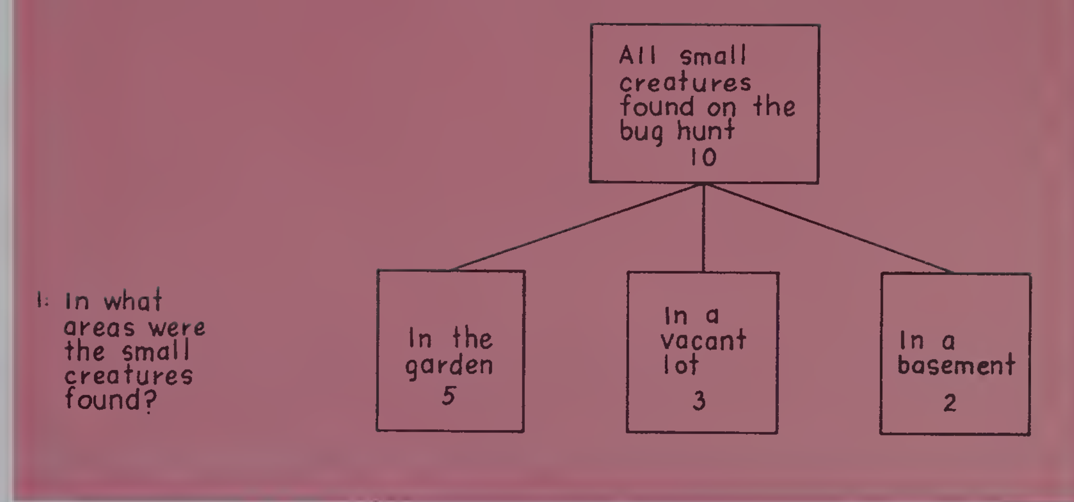
About how long did it take to find each specimen?

Does this length of time tell you anything about how many small creatures live in the areas you searched?

Were some creatures more difficult to catch than others?

What materials could you use to help you collect specimens on your next ''bug huntin' '' expedition?

Study your list of interesting observations, and choose one item. How could you learn more about it? Use your ideas to try to make up an activity of your own.



These children are sorting pill vials into groups. How do they know to what group each small creature belongs?

Activity 2:

How can small creatures be grouped?

For this activity, work with three or four classmates. It is best to join students who collected their small creatures in different places. The group should place all the containers on a table, so that everyone can see all the specimens.

Look at the label of each container.

Sort the containers, so that all the animals that were found in the same places are grouped together. Make a chart of the groupings. It might look like the one at the top of the page.

By grouping your small creatures, you have *classified* them. You have put the creatures into different ''classes''. You have a reason for putting each creature in each group. For example, you may group a ladybug and an ant together because you found them both in the garden. The kinds of groupings you make form a *classification system*.

Print numerals in the boxes on your chart to show how many creatures belong in each group.

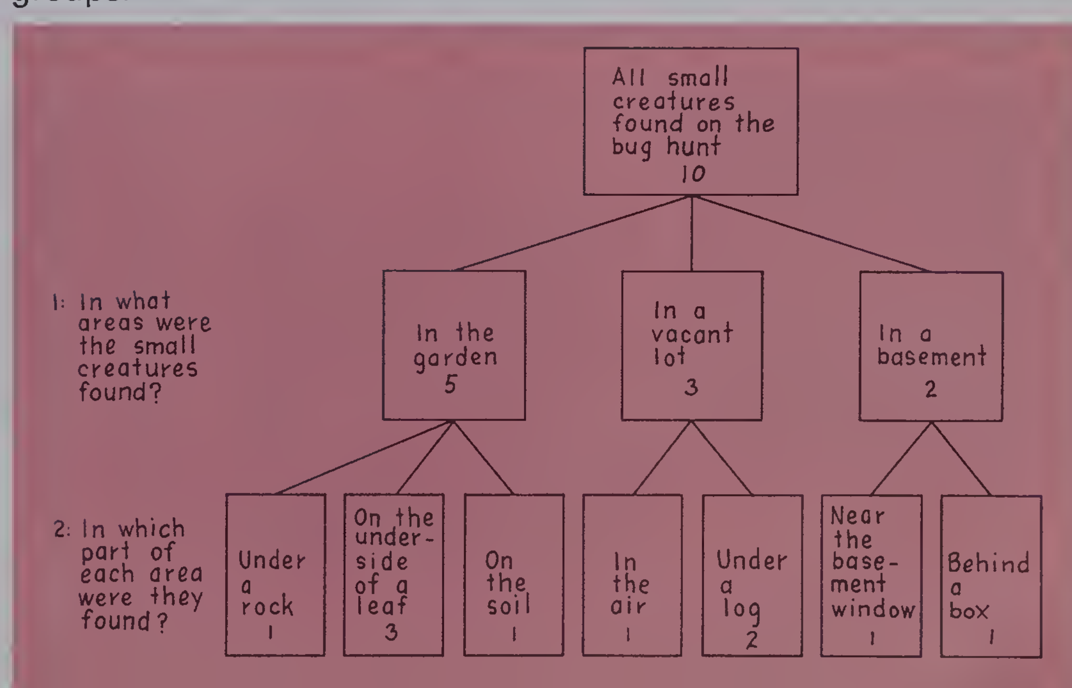
You probably remember not only what the chart shows, but also other things about where you found your small creatures.

Now you can enlarge your classification system, if you separate the groupings in it again. These second groupings should show the different places you found creatures that are already in the same group.

As you separate each group into smaller groups, do you now see the reason for detailed labels on the jars? How did the labels help you?

Draw boxes to show your second groupings on your chart.

The chart below gives you an example of a classification system with more groups.



Which animals were found under the rocks? On leaves? Show the number of small creatures in each group. Draw lines showing which group in the first row was separated to make the second groupings.

You could enlarge your classification system by making even more groups. Was each animal moving or standing still when you first saw it? Do you remember how hard it was to catch?

Separate your groupings again. Then make a third row of boxes showing whether the creatures were hopping, running, walking, flying, or remaining still when you first spotted them.

Think of some other reasons for sorting your creatures. You might separate them into groups of creatures that were feeding and groups that were not feeding. What other information about your animals could you use to enlarge your classification system? Once you decide, you are ready to make more groups.

After you have finished this activity, keep the small creatures in their containers for the next activity. Keep them for only a short time.

Digging Deeper

How many times were you able to add new groups to your classification system? How many rows of boxes does your chart show?

Did the number of creatures in each box grow larger or smaller as you added new groupings?

How many creatures are grouped in the first row of boxes? How many are there in the last row? The total number of creatures in every row should be the same as the number in the first row. Check this on your chart.

Could you continue to add more groupings to your classification system? Would you ever have to stop? Why?

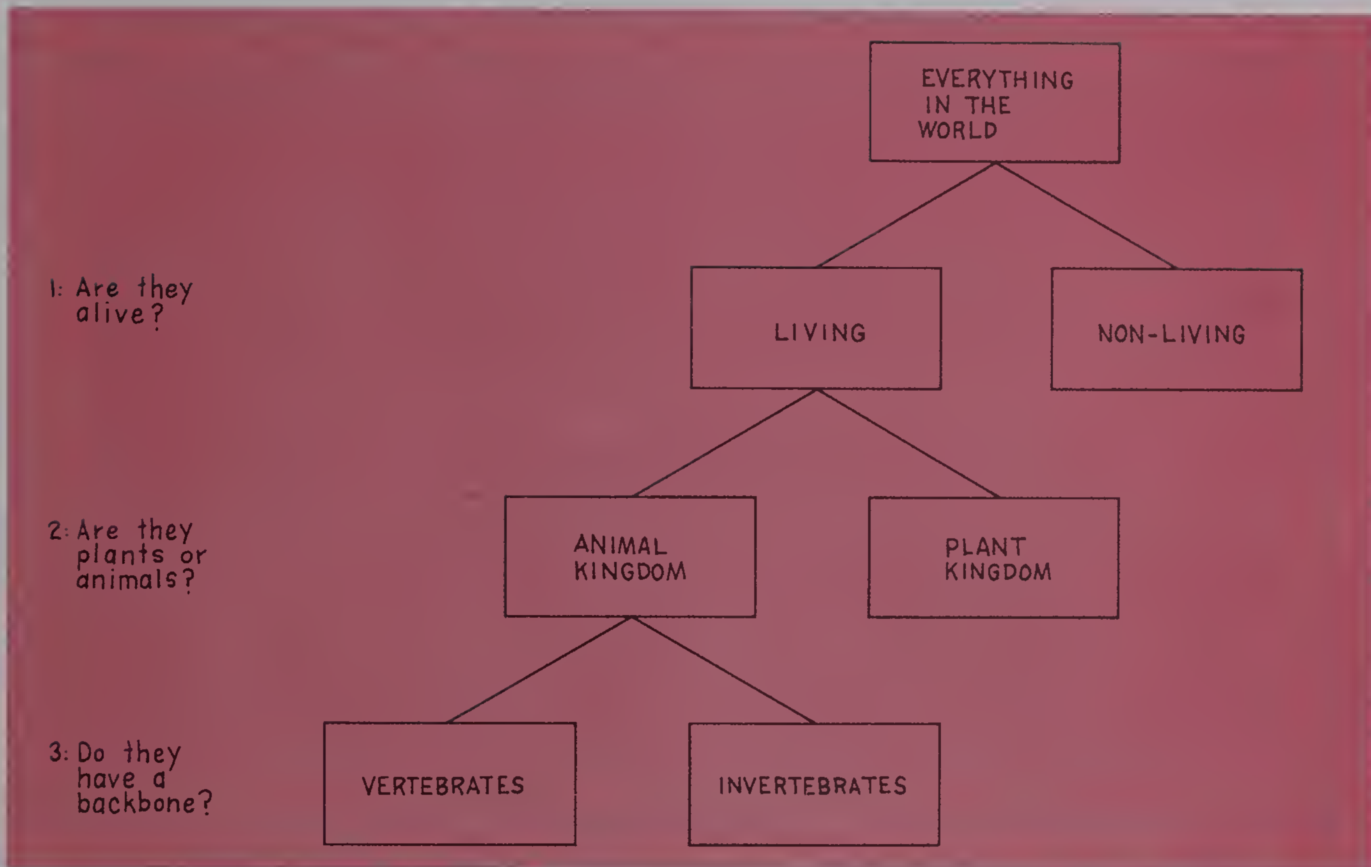
To whom would a classification system such as the one you have developed be useful? Would it be useful to an *exterminator?* How would it be useful to you next time you go bug hunting?

Branching Out

Your class has gathered some specimens of small creatures, but not of all the animals in the world, of course!

Look at the cartoon. Are insects animals? How many different kinds of insects are there?

A classification system for everything in the world.



Can you think of items that belong in each box? Make a list for each group.

You have organized this *sample* of creatures into a classification system.

With so many kinds of insects and other small creatures, it has been a giant task to group all the different types. The scientists who classify things are called *taxonomists*.

You have already practised some simple *taxonomy* (Greek: *taxis*=arrangement, and *nomos*=law) by grouping some creatures as you did. You grouped them according to where you found them, and perhaps, according to what they were doing. How would you classify other things besides small creatures?

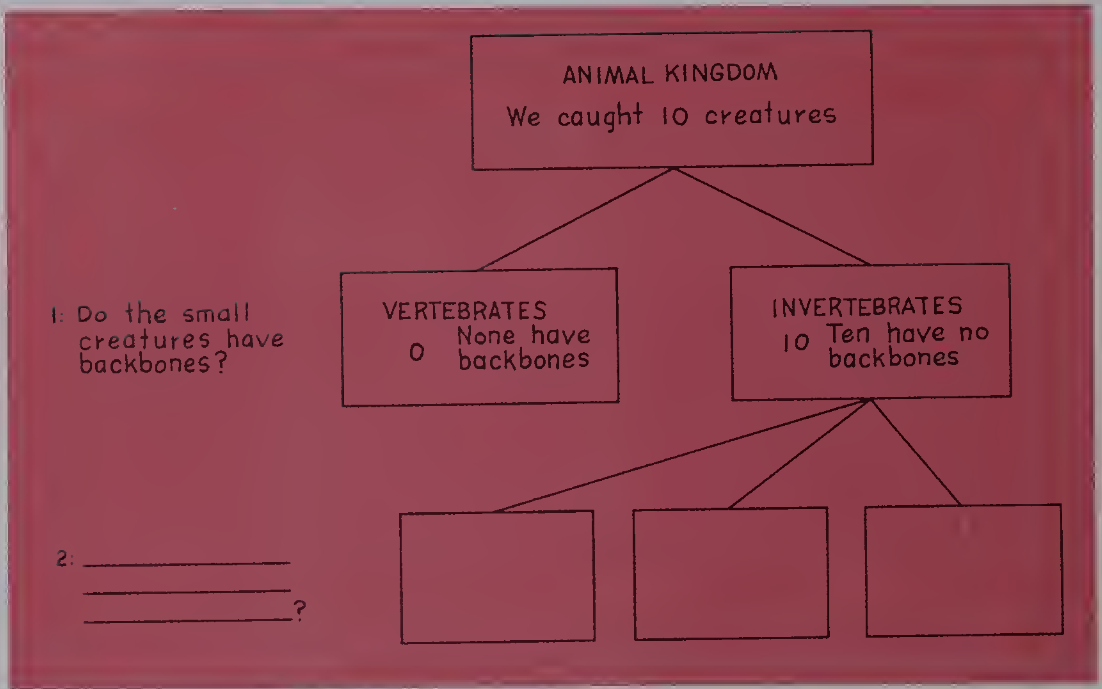
Look at the chart showing a classification system for everything in the world. In which group in each category do your small creatures belong?

Activity 3:

How can small creatures be grouped according to their body parts or structure?

Scientists classify animals according to their body structure. This means that animals with the same kinds of body parts are placed in a group together. This activity should help you to classify the animals that you have collected according to body structure (the kinds of body parts).

If you still have the small creatures that you used for the last activity, you can use them again for this one. If you have set them free, you need to collect different creatures in separate containers again.



Use any of the following reasons to group your creatures. They all have to do with body structure.

1. DO THE SMALL CREATURES HAVE BACKBONES?

Some animals have backbones, but others do not. In the animal kingdom, the first reason for separating animals into different groups is that either an animal has a backbone inside or it doesn't have one.

Animals that do not have backbones (such as snails, worms, spiders, and insects) are called *invertebrates*. Animals that have backbones (such as frogs, snakes, fish, birds, and kittens) are called *vertebrates.*

Are you a vertebrate or an invertebrate? Try to feel your backbone.

If you aren't sure whether your small creatures are vertebrates or invertebrates, ask your teacher. If they are invertebrates, your creatures are already grouped according to this classification system — they are all in the same group!

Make a chart like the one shown, and put your invertebrates into groups.

Each time you add a group to your classification system, draw a new box on your chart. Print numerals in the box to show the number of creatures in that group. Don't forget to write the reasons for your groupings in question form along the side of your chart.

2. HOW MANY MAIN BODY PARTS DO THE SMALL CREATURES HAVE?

Study the photographs.

Three main body parts. ▲

Two main body parts. ▼

One main body part.

Look at each specimen. You need to look at it very closely to group it properly. That is because these animals are quite small. Perhaps a hand magnifier could be used to look at each creature. Does the creature seem to have a waist? Does the head look as though it is a different body part? Or does the creature look as though it is all body?

Make groups by placing together the jars containing all the animals with one main body part. Place the creatures with two body parts in another group, and the ones with three parts in a third group. Complete the boxes to show your findings.

3. DO THEY HAVE WINGS?

Add new groupings by putting creatures with wings in a different group from the creatures without wings. Some small creatures have wings which are hidden beneath hard wing cases. Use a toothpick to gently probe along the backs of animals which might have hidden wings.

Add boxes to your chart to show these groups.

Do these creatures have wings?

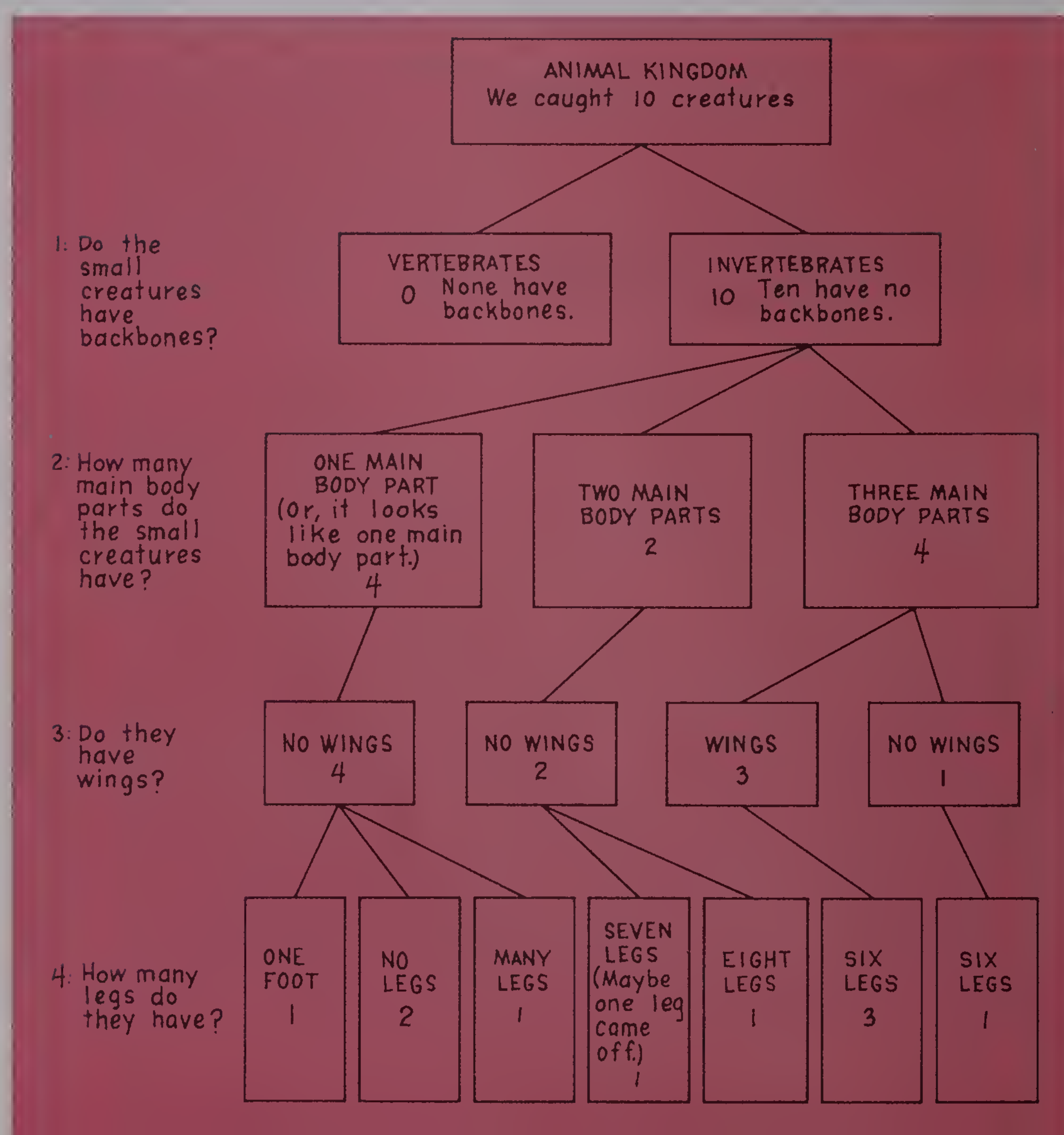
4. HOW MANY LEGS DO THEY HAVE?

Group according to whether each creature has many legs or no legs. Show this information on your chart.
Continue to add to your classification system. You might use some of these reasons for your groupings:

type of shell or no shell at all;
furry or shiny appearance;
tails or pincers at the rear end, or a smooth rear end;
antennae or no antennae.

Find out what body *segments* are. Perhaps some of your creatures can be grouped according to whether they have many body segments or not.

An example of a classification system. How is this one like yours?



Digging Deeper

How many times could a small creature be classified in your classification system?

How many different groups are there for the number of main body parts?

How many different groups are there for the number of legs?

Is the total number of creatures in the groups for each question the same as the total number of creatures caught? Check this on your chart. Count the total number of creatures in each row.

Are more groups formed every time a new row is added?

What happened to the number of creatures in each box as you made more groups? Explain your answer.

Look at each animal group in the second row of the classification system. Are the creatures in the same group very much alike? Are they very different?

Now look at the creatures in the last row of your chart. Look at all the creatures in any one group. Are they as different from each other as the creatures of a group in the second row?

What differences in wings did you notice? How many boxes showing wing differences could be added to your chart?

Branching Out

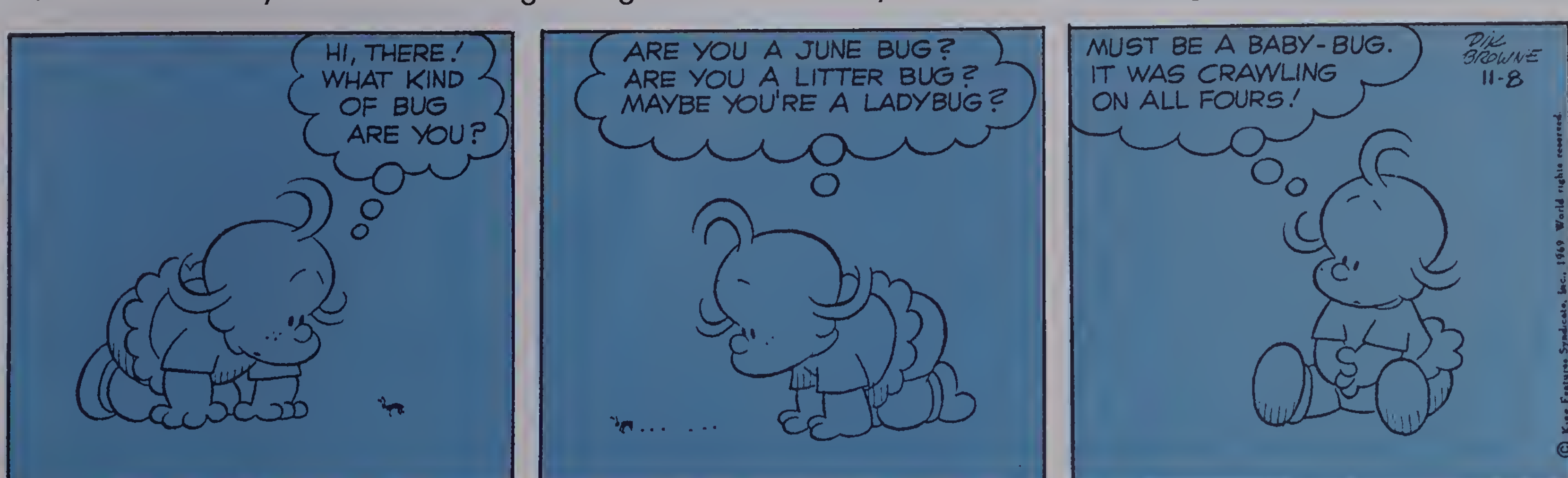
"A classification system is neither right nor wrong. Instead, it is useful or useless." Do you agree?

Sometimes a classification system is never completed. Newly discovered animals may have to be classified. Other times, a creature that has already been classified must be put in a different group, because something new has been found out about that creature.

New discoveries are made because of modern methods and equipment. These discoveries make the taxonomist change his or her mind about which group the creature belongs in.

Use books from your school or public library to learn about the classification systems of John Ray (1628-1705) and Carolus Linnaeus (1707-1778). Carolus Linnaeus is the name of Karl von Linné in Latin.

Taxonomists are concerned not only with classifying things in their proper groups, but also with giving them names. As the cartoon shows, people feel that they have to name things.



Activity 4:

How can an identification key be used to identify small creatures?

Don't worry if you do not know the names of the types of small creatures you have collected. Memorizing a great many names is not really very important. But if you want to learn the name of an animal, it is important to learn how.

An *identification key* will help you identify your small creatures. It is a description that explains how animals are grouped or classified. The identification key is a "key" to unlock the "door" that will lead you to identify the mystery creatures.

Here is how the identification key in this book is used:

Look at the description inside the heavy borders of each animal group.

If that description fits your creature, look at each box within the borders. Which of the descriptions comes closest to describing your creature? What is the creature's name?

If that description doesn't fit your creature, go on to the next description inside heavy borders. Continue to compare the descriptions in each section with your creature until you find the one that fits your creature. What is its name?

(Note: These small creatures may not be shown in their actual sizes. Also, if you found your small creature in the water, this key will not be of much use, since it is a key for land animals.)

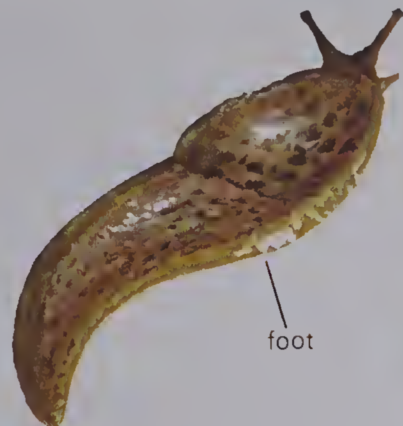
What is the name of the small creature in each of these photographs?

IDENTIFICATION KEY FOR SMALL CREATURES

SMALL CREATURES WITHOUT LEGS

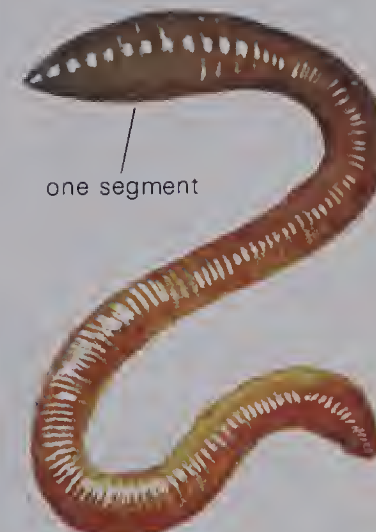
If it has no legs and no wings, observe its body.

If the animal has a shell, two pairs of tentacles, and a slimy foot, it is a SNAIL.



If the animal has no shell, two pairs of tentacles, and a flat slimy foot, it is a SLUG.

If the animal has no shell, and the body is made up of thirteen or fewer rings called segments, it is an insect LARVA.



If the animal has no shell, and the body is made up of more than 100 rings called segments, it is an EARTHWORM.

If the animal is not like any of these, it is probably an insect PUPA. Keep your pupa in a box with damp peat moss to see what it turns into.

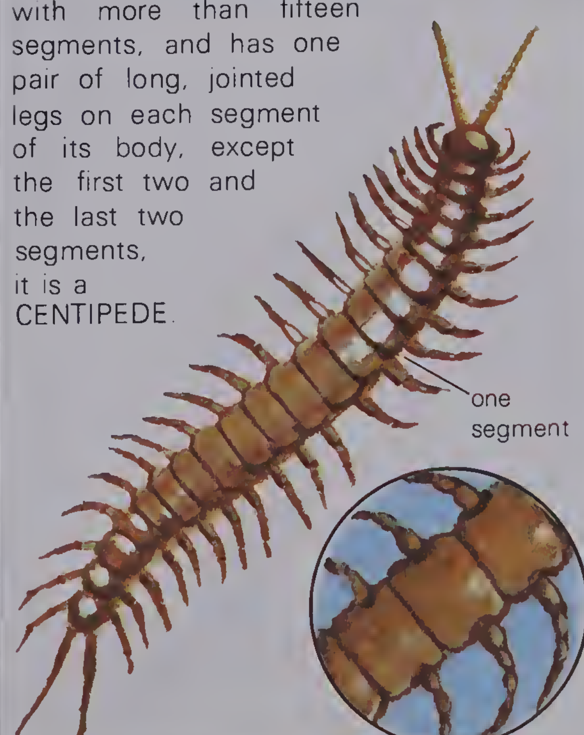
SMALL CREATURES WITH MORE THAN EIGHT LEGS

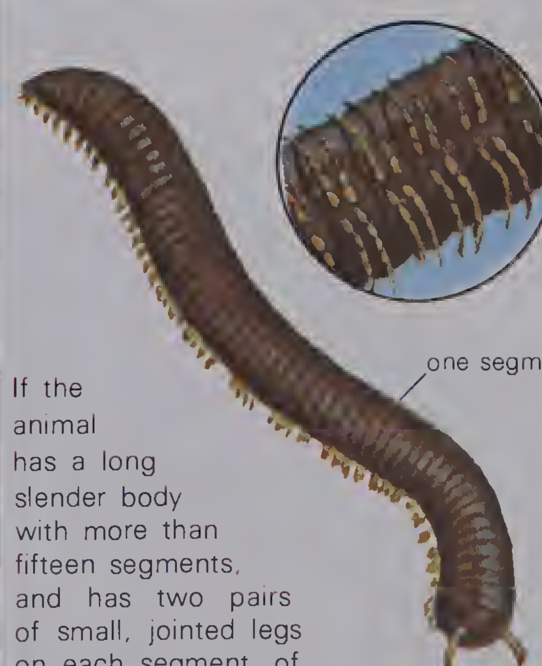
If it has more than eight jointed legs and no wings, it is a CENTIPEDE, MILLIPEDE or WOODLOUSE.

If the animal has an oval-shaped body with less than fifteen rings called SEGMENTS, and appears to have similar legs on most of them, it could be a WOODLOUSE.

If it rolls into a ball when you touch it, it is a PILL WOODLOUSE or PILL BUG.

If the animal has a long slender body with more than fifteen segments, and has one pair of long, jointed legs on each segment of its body, except the first two and the last two segments, it is a CENTIPEDE.

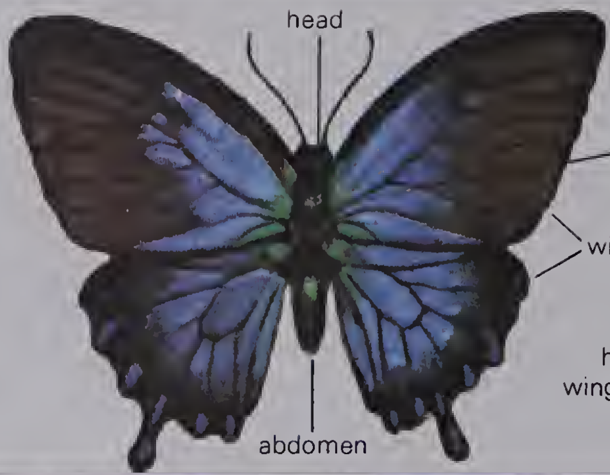




If the animal has a long slender body with more than fifteen segments, and has two pairs of small, jointed legs on each segment of its body, except the head and the last two segments, it is a MILLIPEDE.

WINGED INSECTS

If it has wings, six jointed legs, and three parts to its body (head, thorax, and abdomen), it is an INSECT. Look carefully at the wings of the animal.



BUTTERFLIES AND MOTHS

If the animal has two pairs of wings with powdery scales,

look carefully at its feelers.

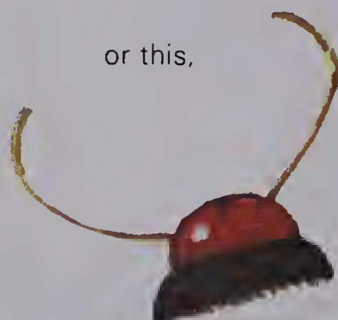
These are called antennae.

scales on a part of the wing

If the antennae are without a club and look rather feathery,

like this,

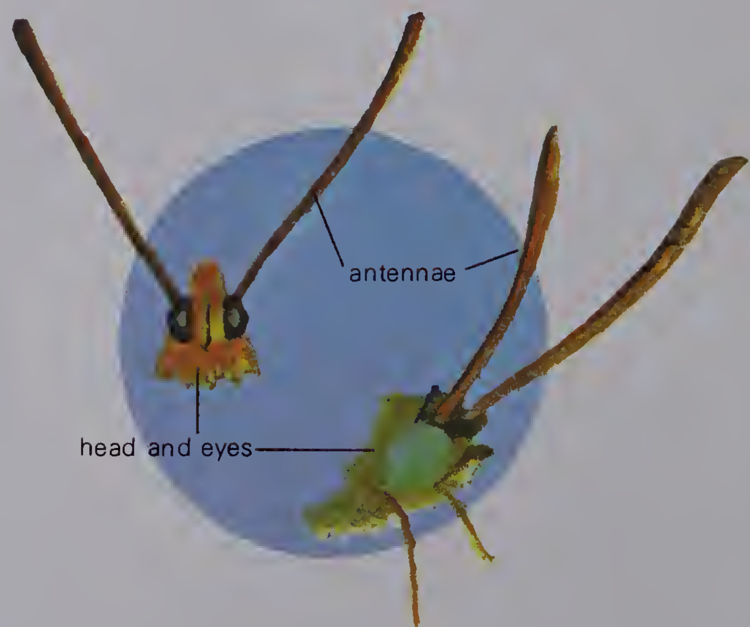
or this,



or this,

it is a MOTH.

If the antennae have a club-shaped end,



the animal is a BUTTERFLY.

INSECTS WITH 2 PAIRS OF TRANSPARENT WINGS

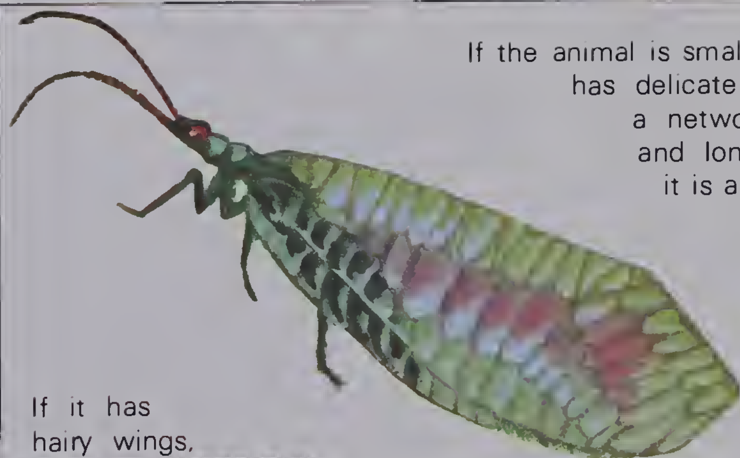
If the animal has two pairs of transparent wings with veins, look carefully at the wings, the veins, and the size and shape of the abdomen.

If the animal has wings with few veins and a short abdomen with a waist, it belongs to the BEE, WASP, and ANT group.

If the animal has wings like this but no waist, it is a SAWFLY.

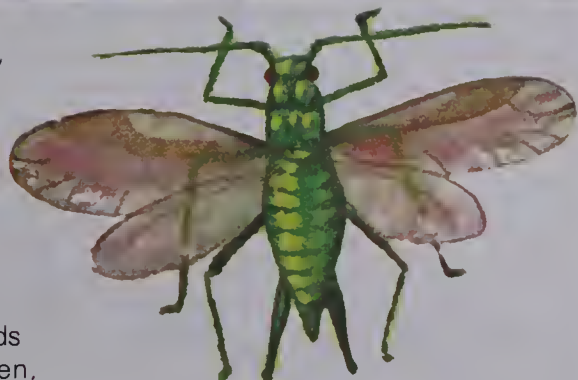
If the animal has hind wings very much smaller than the fore wings and rests with its wings upright, and if its abdomen has long tail filaments, it is a MAY FLY.

If the animal has hairy wings with very few veins across them, the fore wings smaller than the hind ones, and a slender abdomen, it is a CADDIS FLY.

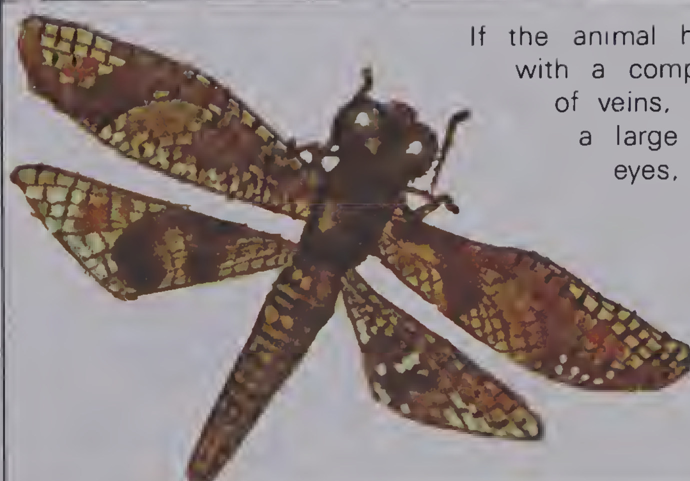


If the animal is small and green, has delicate wings with a network of veins, and long antennae, it is a LACEWING.

If it has hairy wings, it is an ALDER FLY.



If the animal is very small and green, black, yellowish, or brown, has wings with few veins, the hind wings smaller than the fore wings, has two points towards the end of its abdomen, and long antennae, it is an APHID. (Green flies, black flies, and others.)



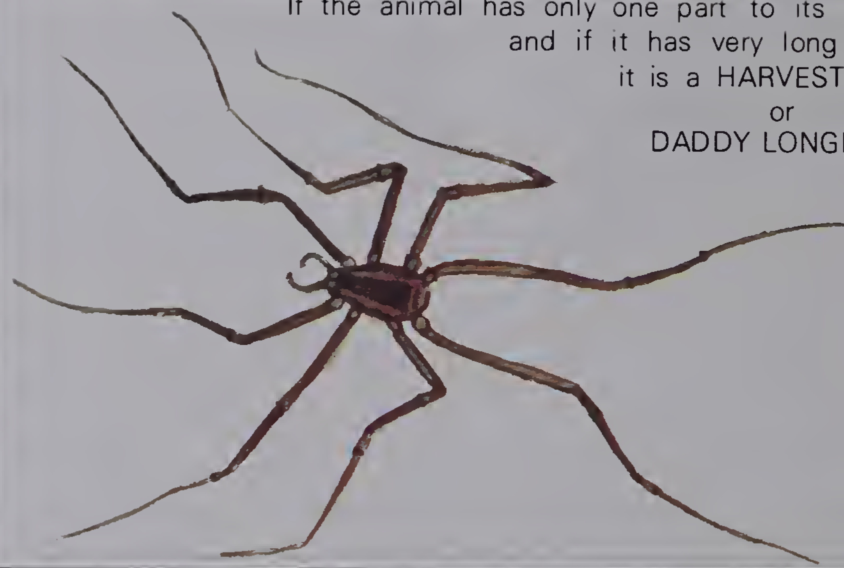
If the animal has large wings with a complicated network of veins, small antennae, a large head, very large eyes, and a slender abdomen, it belongs to the DRAGONFLY family.

SPIDERS

If it has no wings, eight jointed legs, and only one or two parts to its body, it belongs to the SPIDER group. Look carefully at the body of the animal.

If the animal has two parts to its body, with the legs attached to the front part, it is a SPIDER.

If the animal has only one part to its body, and if it has very long legs, it is a HARVESTMAN or DADDY LONGLEGS.



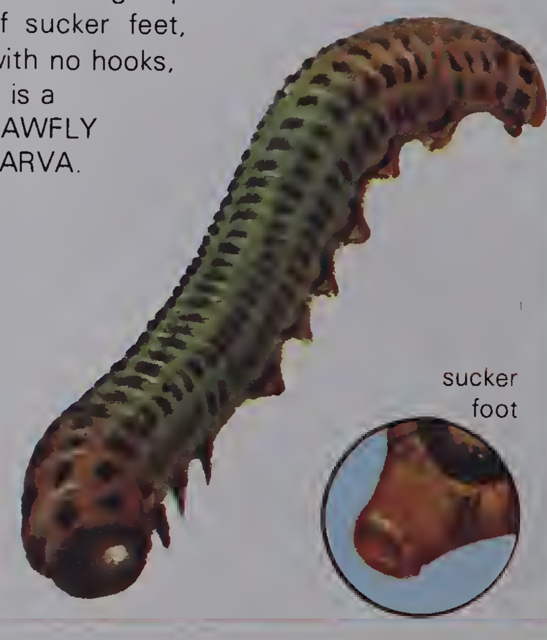
CATERPILLARS

If it has six jointed legs, some sucker feet, and no wings, it is a young insect called a CATERPILLAR.
Using a magnifying glass, look carefully at the caterpillar's feet.

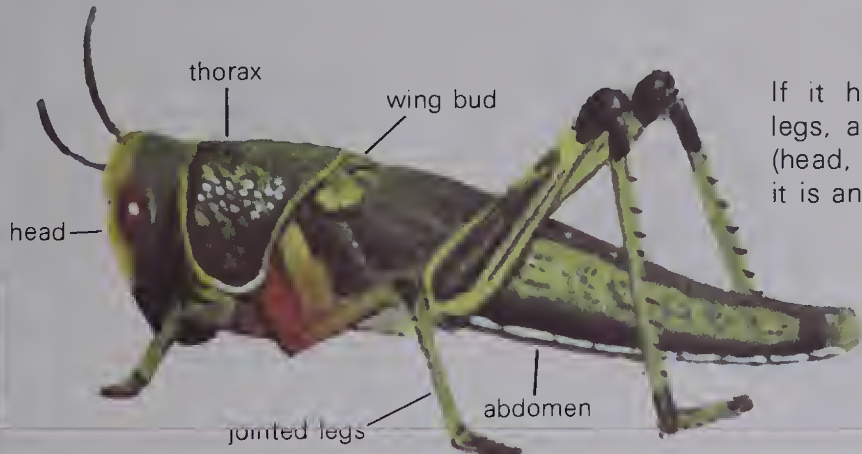
If the animal has five pairs of sucker feet, all with hooks, it is the LARVA of a BUTTERFLY or MOTH.

If the animal has only two pairs of sucker feet with hooks, it is a LOOPER CATERPILLAR, the LARVA of a MOTH.

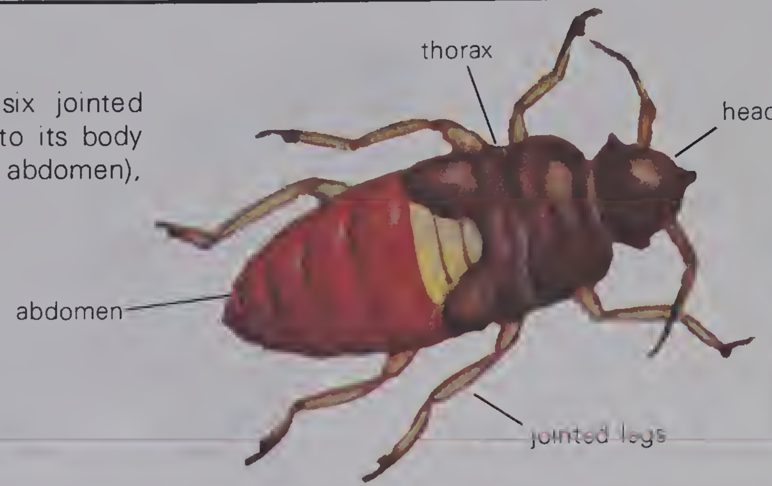
If the animal has from six to eight pairs of sucker feet, with no hooks, it is a SAWFLY LARVA.



WINGLESS INSECTS WITH THREE BODY PARTS



If it has no wings, six jointed legs, and three parts to its body (head, thorax, and abdomen), it is an INSECT.



If the animal has no sign of wings and an abdomen with a very small waist, it is an adult ANT.

If the animal has no sign of wings, and if its abdomen has no waist, it is either an APHID

or a young LARVA.

If the animal has small wing buds, it is a young insect called a NYMPH.

(Beware: don't confuse hard wing cases, such as those of an earwig, with wing buds.)

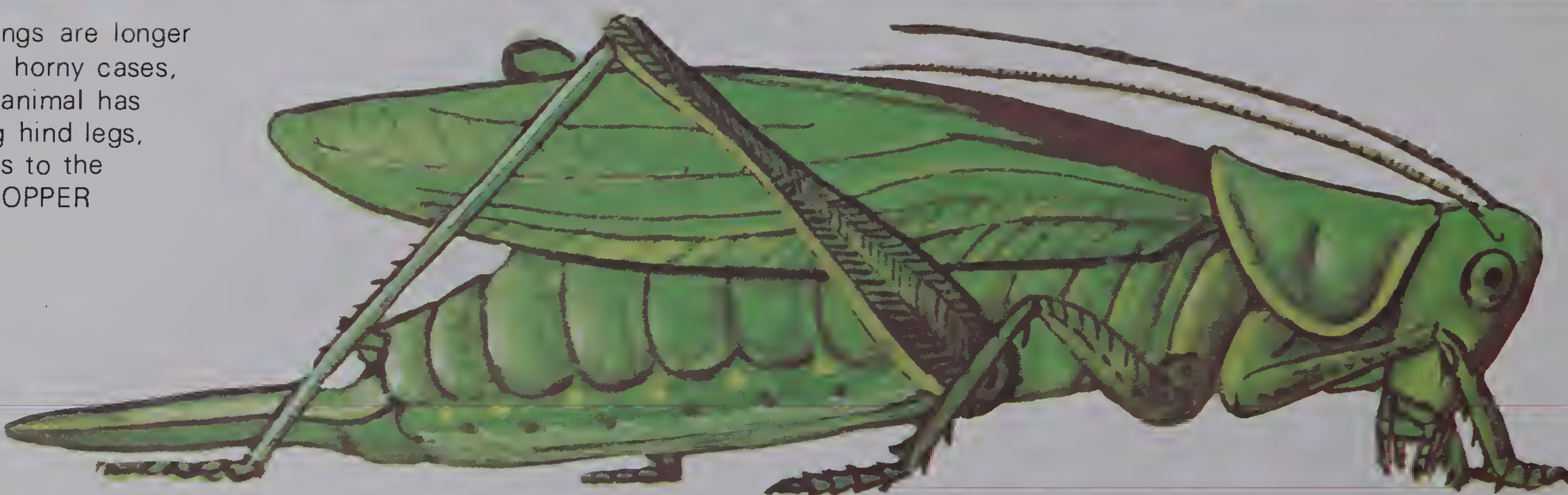
INSECTS WITH HARD WING CASES

If the animal has
two pairs of wings
in which the upper wings
form a hard cover and
the lower wings are
transparent,
look carefully
at the hard wing cases.

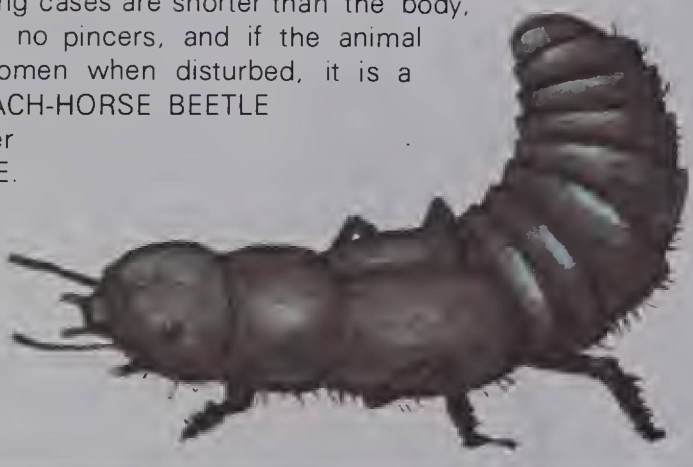
If the hard wing cases
cover most of the body,
the animal belongs
to the BEETLE group.

If it has
hard wing
cases and a
shield-like part
(scutellum)
on its back,
the animal is a
FROGHOPPER
or other BUG.

If the wings are longer
than the horny cases,
and the animal has
very long hind legs,
it belongs to the
GRASSHOPPER
group.



If the hard wing cases are shorter than the body,
but there are no pincers, and if the animal
rears its abdomen when disturbed, it is a
DEVIL'S COACH-HORSE BEETLE
or some other
ROVE BEETLE.

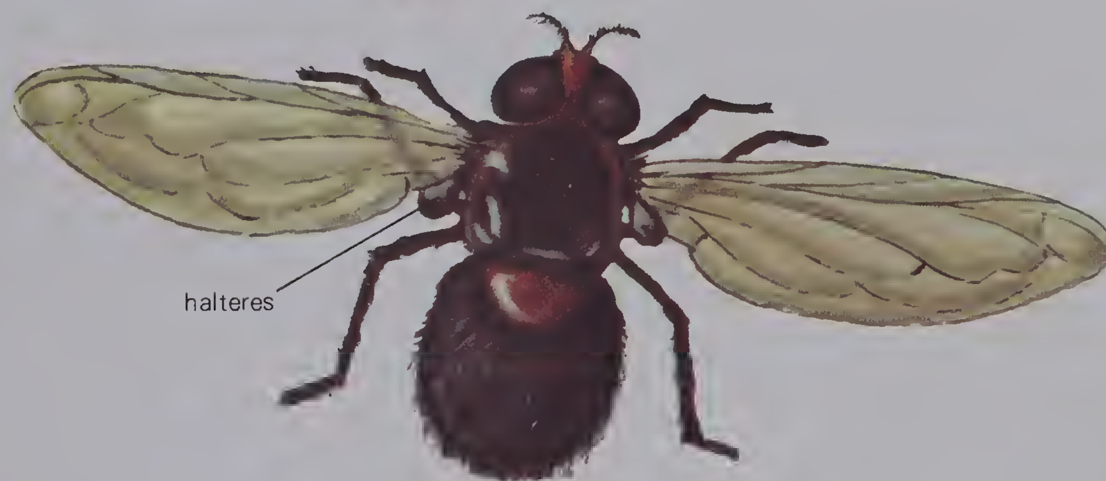


If the hard wing cases cover the wings and are shorter than the body, and if the animal has a pair of pincers at the end of the abdomen, it is an EARWIG.

INSECTS WITH ONE PAIR OF WINGS

If the animal has only one pair of wings, it belongs to that group of true flies which may sometimes be mistaken for bees or wasps.
If you use a magnifying lens, you see two small balancing organs, called halteres, in place of hind wings.

If the animal has a body that is almost as thick as it is long, often covered with thick, bristly hairs, it belongs to the group of SHORT-HORNED FLIES.



If the animal has a humped thorax, a slender abdomen, long legs, and is large, it is a CRANE FLY.

If the animal has a humped thorax, slender abdomen, and is small, it belongs to the group of MIDGES and MOSQUITOES (Gnats).

Look at the small creatures in the photographs. Can you use a key to identify them?

Try to identify the other creatures you have collected. You may find *field guides* and other books to help you.

Digging Deeper

How many creatures were you able to identify?

What was the most common creature caught by your whole class? Which ones were the least common?

Branching Out

Can you solve the small creature puzzle?

Try to make your own small creature puzzles. Your drawings might resemble real creatures, or they might be animals never seen before. Test your friends and family with your puzzles.

SMALL CREATURE PUZZLE

Al and Jay returned from "bug huntin'" with small creatures which they separated into groups. Pill vials containing these small creatures were labelled *kanizers:*

None of the pill vials containing these small creatures were labelled *kanizers:*

Which of these creatures would the boys have labelled *kanizers?*

Shoo, Fly! 2

2. *Shoo, Fly!*

If someone dares you to a foot race, you might agree to run. What would you say about the race if you had to run backwards while your friend ran forwards?

To have a *fair* race, the rules must be kept the same for both runners. For example, the distances run have to be kept equal. What other things have to be kept the same? Starting time? The type of shoes? Clothing? Objects in the paths of the runners?

If all you want to know is, Who is the faster runner?, then everything must be kept the same for both runners. Only their speeds may be different. Only then can you have a 'fair' foot race.

In science experiments, as in games and races, you must also be 'fair'. In a science experiment you are interested in discovering only one thing at a time. To make sure that only one thing changes, everything else must be kept the same. A 'fair' experiment in science is called a *controlled experiment*. After you complete the activities in this chapter, you will know how a controlled experiment is done. The activities in this chapter are to be done with flies — common everyday house flies!

While you are making discoveries about flies, someone in your group might start an experiment that in some way isn't 'fair' or controlled. If this happens, you should jump up and exclaim: "That isn't 'fair'!" Then you should explain why the activity isn't 'fair', and decide what to do to make it a controlled experiment.

Activity 1:

What is a simple way to catch house flies?

There are many ways to collect house flies. The photographs show some of these methods.

Why don't these two methods of catching house flies usually work?

Gotcha!

If you handle a captured house fly, do not put your hands near your mouth or face. Wash your hands when you have finished.

You might try catching a fly in a large aquarium net. Care must be taken when you take the house fly from the net, or you might lose it. Force the fly to a part of the net where it can be cornered by bunching the net in your fingers. Take an open pill vial with your other hand, and ease the fly into the pill vial. When you replace the cap, your fly is captured at last.

Collect a total of twenty-five house flies, and put them in separate containers.

Digging Deeper

In what places did you look for house flies?

Which places were best for catching house flies?

How would you explain how to use the net to someone who has never gone fly-catching?

How many house flies escaped?

Branching Out

Study some of the house flies that you have captured. Although a fly is considered to be a dirty animal, do you notice how carefully it rubs its legs and wings? Does it appear to be cleaning itself? How is this done?

What does its mouth look like?

With your hands, slowly turn the pill vial in which a fly was captured. Can a fly walk upside down? What enables a fly to do this? Can a fly cling to the sides of the vial? Or is it too slippery?

Do you notice how quickly a fly beats its wings? How is this different from the way a bird flaps its wings? How many pairs of wings does a fly have? Look at the illustrations showing a male house fly and a female house fly.

A male house fly has a dark patch at the tip of the abdomen. Its eyes almost join at the top of the head.

The abdomen of the female house fly becomes swollen with eggs about six days after becoming adult. Its eyes are widely separated at the top of the head.

Do your pill vials contain both *sexes*? You need both male and female house flies to do most of the activities that follow.

Mark on each pill vial whether the fly inside is male or female. How many do you have of each?

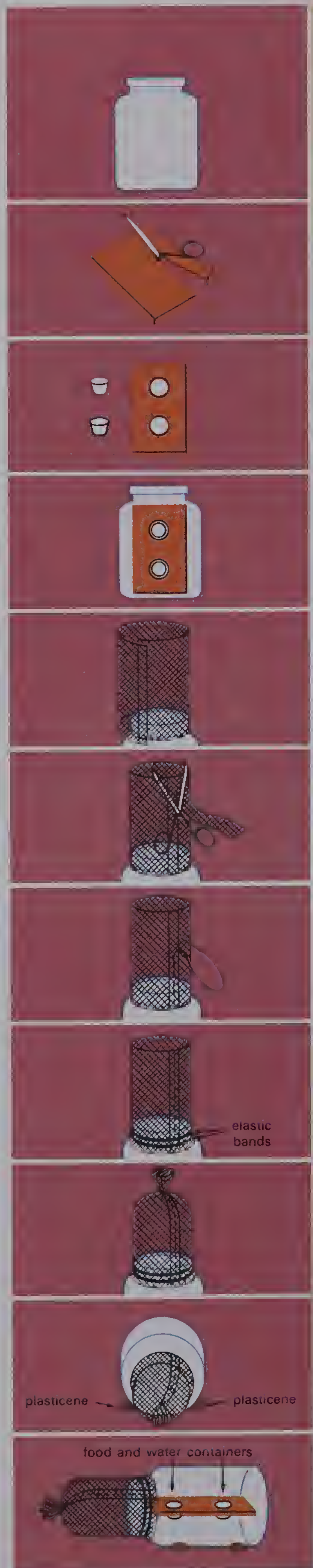
House flies certainly have a bad reputation. Most people think of flies only as dirty animals that carry harmful germs. It's true that house flies carry man's germs. House flies live with man all over the world and pick up germs from animal and human wastes. As flies move from place to place, they carry the germs with them. This is how they spread diseases.

In this activity you were told to keep your hands away from your mouth and face after handling a house fly. Why is this a good idea?

In this chapter most of the house flies that you study are hatched in a house fly colony away from human and other animal wastes. With fewer germs available for the house flies to carry, you might feel better about handling them. It is still a good idea to wash your hands thoroughly after each activity using house flies.

Although many kinds of flies can bite, house flies cannot because their mouth parts are made for sucking. Watch how one of your flies feeds on some grains of sugar.

There is no need to fear these house flies.



HOW TO MAKE A HOUSE FLY CAGE

A. Get a wide-mouthed jar with a capacity of about 4ℓ. A large pickle or mayonnaise jar would be suitable.

B. Cut a piece of cardboard so that it fits into the jar.

C. Find two empty plastic cream containers, the kind used in restaurants. Cut two holes in the cardboard, so that the plastic containers just fit into the holes.

D. Bending the cardboard a little, place the cardboard and the plastic containers into the jar.

E. Now you need some lightweight cheesecloth to use as a sleeve around the mouth of the jar. Fit the netting around the neck of the jar.

F. Cut the material so that there is a two-centimetre overlap.

G. Sew along the overlap, joining the two opposite edges.

H. Use a large elastic band to hold the material firmly to the neck of the jar. Place another elastic band over the mouth of the jar, so that the flies cannot be trapped between the material and the glass.

I. At the other end of the sleeve, use a very small elastic band to keep it closed.

J. Turn the cage on its side, and wedge some plasticene under both sides so that it doesn't roll.

K. Your cage is complete!

Activity 2:

How can a fly colony be set up?

Now that you have twenty-five houseflies from Activity 1, you need a place to keep them. If you place the pill vials of flies in a bag, and put the bag in a refrigerator for two hours, their movements become slow enough for you to put them into a cage more easily.

In this activity, you can make a suitable cage for your flies if you follow the directions in the diagram.

When you are ready to put the flies into the cage, open the sleeve by removing the small elastic band. Fill one plastic cream container in the jar with a piece of water-soaked cotton and the other with dry or powdered milk. The cotton keeps the flies from drowning in the water.

Now, take the pill vials, one at a time, from the refrigerator, and put the flies into the cage. Place all the flies in the cage. To keep the flies from getting out, close the opening in the material with the small elastic band, and tie a loose knot in the material.

Digging Deeper

Why was it a good idea to put the flies in the refrigerator?

How long did it take for the flies to become active again?

How often do the flies visit the food and water containers?

Describe the appearance and the behavior of the flies in the colony.

It has been said that house flies are the *entomologist's "white mice".* What does this statement mean?

These students are getting ready to use their house fly colony for an experiment.

Activity 3:

Where do house flies prefer to lay their eggs?

In this activity, it is important to be as 'fair' as possible. Read the introduction to this chapter again.

Now, let's do a controlled experiment. You should find out the house fly's choice between two different materials in which the flies might lay their eggs. This is like a race between the two materials to see which one the flies choose. The material with the most eggs in it at the end of the experiment will be the material which the house flies prefer. How can you make sure this activity is 'fair'? The difference between the types of material should be the only difference in the whole experiment.

To keep everything the same, do the following things:

(a) Place the two egg-laying materials in the same fly colony, so that, for those materials, the flies are the same, and the cage is the same.

(b) The materials should be left in the cage for the same length of time.

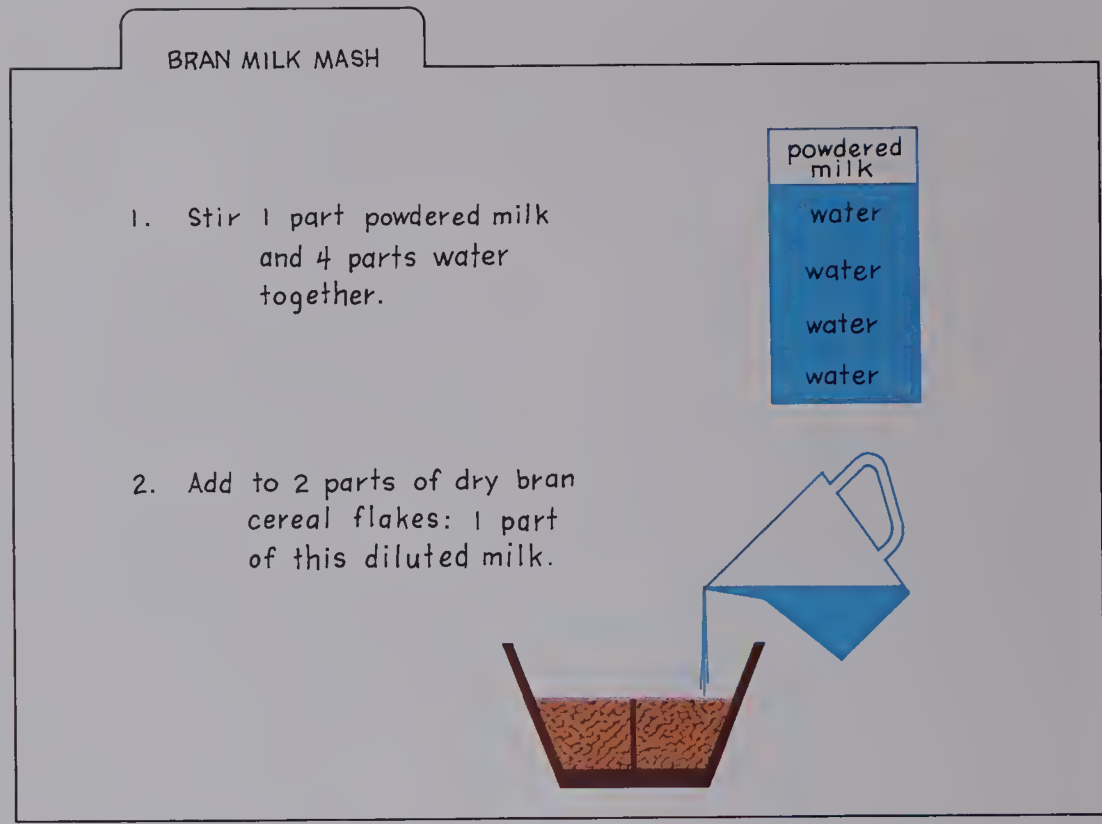
(c) The containers in which you place the materials should be identical.

(d) The amount of material in each container should be the same.

Now, on with the experiment.

Get two more empty plastic cream containers. In one container, put dry bran cereal flakes.

Make a mixture of bran cereal flakes and diluted milk. Follow the recipe in



the picture. Put this mixture in the second container.

Place the two containers of egg-laying material in the cage with the twenty-five house flies. Leave the containers in the cage for twenty-four hours (one full day).

At the same time on the next day, remove the two containers from the cage. Examine the two containers for eggs. A house fly egg is very small, whitish in color, and shaped like a sausage. A hand magnifier can help you to count and study fly eggs.

Look under the bran flakes in both

How big is a house fly egg?

plastic containers for eggs like the ones in the photograph. Which cup has more eggs? Record your findings by making a chart or diagram of the eggs in the two containers. If there are no eggs in the two containers, make new mixtures of egg-laying material, and return the containers to the cage to repeat the twenty-four hour waiting period.

Once the eggs have been laid, save them, because they are needed for your next activity.

Digging Deeper

In which material did the flies choose to lay their eggs?

Why do you think flies prefer one type of material to another for laying their eggs?

On what materials in nature do you think flies prefer to lay their eggs?

Was this a 'fair' activity? Explain your answer.

Activity 4:

What hatches from a house fly egg?

Get a large, plastic, ice cream (or artificial whipped cream) container like the one shown in the photograph. A container of clear plastic is best. Make a bran-milk mash following the directions in Activity 3.

Fill the plastic container with bran-milk mash.

Add about one hundred fly eggs from the egg-laying material that you used for Activity 3. Add the eggs to the bran-milk mash without touching them with your hands. Use a toothpick or a straight pin.

Then, lightly stir the eggs into the bran-milk mash. Cover the plastic container with a napkin. Stretch an elastic band around the mouth of the container to hold the napkin firmly in place.

Keep the container in a warm, but not hot, spot in the classroom.

Most of the fly eggs will hatch within twelve hours into worm-like creatures called *maggots* (or fly *larvae)*.

If the bran-milk mash becomes too dry, make more and add it to the container.

MAGGOTS. Chart of Daily Observations					
	Day 1	Day 2	Day 3	Day 4	Day 5
Size					
Color					
Movement					
Place found in the bran-milk mash					

Use a hand magnifier to look at the eggs and larvae several times a day for five days.

Record your observations on a chart like the one shown.

On the third or fourth day, collect just enough larvae for you and your classmates to have at least one each. Study your larva with a hand magnifier. This time, make a detailed drawing of what you see.

On the same day, remove the napkin and the elastic band from the bran-milk mash container. Put a baby food jar cap in a different, much larger container which has a lid. On top of the baby food jar cap, place the bran-milk mash container. Place the lid on the large container.

Watch what happens to the larvae on the fourth, fifth, and sixth days.

Digging Deeper

What changes in the size of the maggots (or larvae) did you notice?

Does a maggot have a front end? A rear end? Does a larva have a top? A bottom? Does a maggot have legs? Eyes? A mouth?

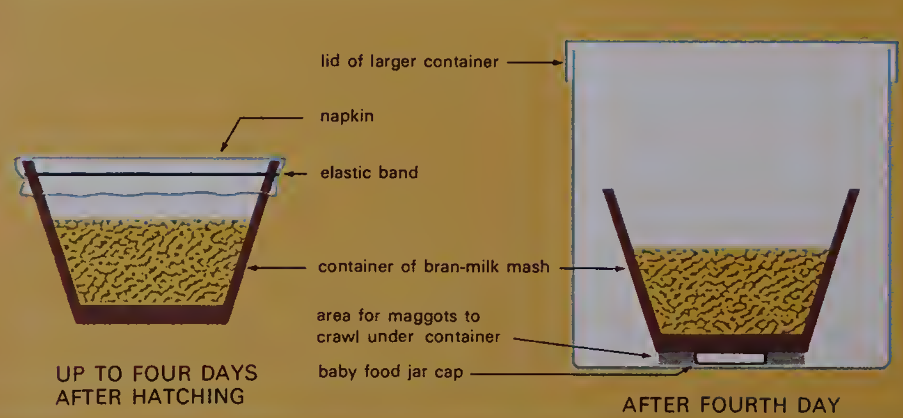
How does a larva move? How many different ways can a maggot move?

What changes in movement did you notice after the fifth day? This movement is known as ''maggot migration''. Find out what *migration* means.

Why do you think that the larvae migrate away from their source of food?

What changes in color did you notice? What was happening to the larvae at this time?

RAISING MAGGOTS IN A CONTAINER OF BRAN-MILK MASH



Branching Out

AN EXPERIMENT WITH MAGGOTS

What effect does light have on maggots?

You will find out the maggot's choice between light and no light. This is like a race between the lighted side and the dark side. Which do the maggots prefer? How do the maggots react to light?

This activity must be done during the third or fourth day of the larvae's life. Obtain a shallow box, such as a chocolates box or a Christmas card box. Cut the lid so that it covers only one-half of the box. Place ten larvae in the box at the center.

Shine a flashlight on the center of the box from above, about one metre away. Make sure that the shadow line divides the box into equal parts. Let the light shine for ten minutes.

Make a chart like the one shown.

After you have waited for the maggots to move, count the number of larvae in each half of the box. When you have finished counting the numbers of larvae found in each half of the box, print your results on the chart. Do the experiment again. Does the same thing happen once more? Try it again for the third time.

Study your completed chart to answer the following questions:

How many maggots were in the lighted, open half of the box each time?

How many larvae were in the darkened, covered half of the box each time?

Why do you think more larvae might be found in one half of the box when the flashlight is on?

Why should you wait the same length of time for the larvae to react?

Why is it a good idea to repeat the activity so many times?

When the Flashlight Was On, How Many Maggots Were Found in Each Half of the Box?

Number of times the experiment was done	Number of maggots in the lighted half	Number of maggots in the darkened half
1		
2		
3		

You can see the light from a flashlight. Can you feel the light from a flashlight? Try to feel the heat by putting your hand in front of the flashlight. Could the larvae have chosen one half of the box, not because of the light, but because of the heat? How would you use a thermometer to find out?

What effect do you think light has on maggots? Explain your answer.

In what types of places would you expect to find maggots in nature?

Was this a 'fair' experiment? Was everything except one thing kept the same for this experiment? Was light or no light the only difference? What about heat?

WHAT OTHER EXPERIMENTS CAN YOU DO WITH LARVAE?

Now it is your turn to develop your own experiment. Choose one of the photographs. What question goes with the photograph? Write that question on a piece of paper. In your experiment, you are going to try to answer this question.

Do larvae prefer a rough surface to a smooth surface?

Which parts of the maggot's body are sensitive to a pin point?

Do larvae prefer dampness to dryness?

Do larvae prefer one color to another?

Next, write down the one thing that you will change in the experiment.
Why have you chosen to make that change?
Next, list everything that must be kept the same in the experiment.
As you do the experiment, keep a record of what you have seen.
What is the answer to the question you have chosen?
Was your experiment 'fair'? Explain.

When you have finished your activity, leave the larvae overnight in the container in which you were experimenting. See what, if anything, has happened by the next day. How long have the house flies remained as larvae?

Activity 5:

What happens to a mature maggot?

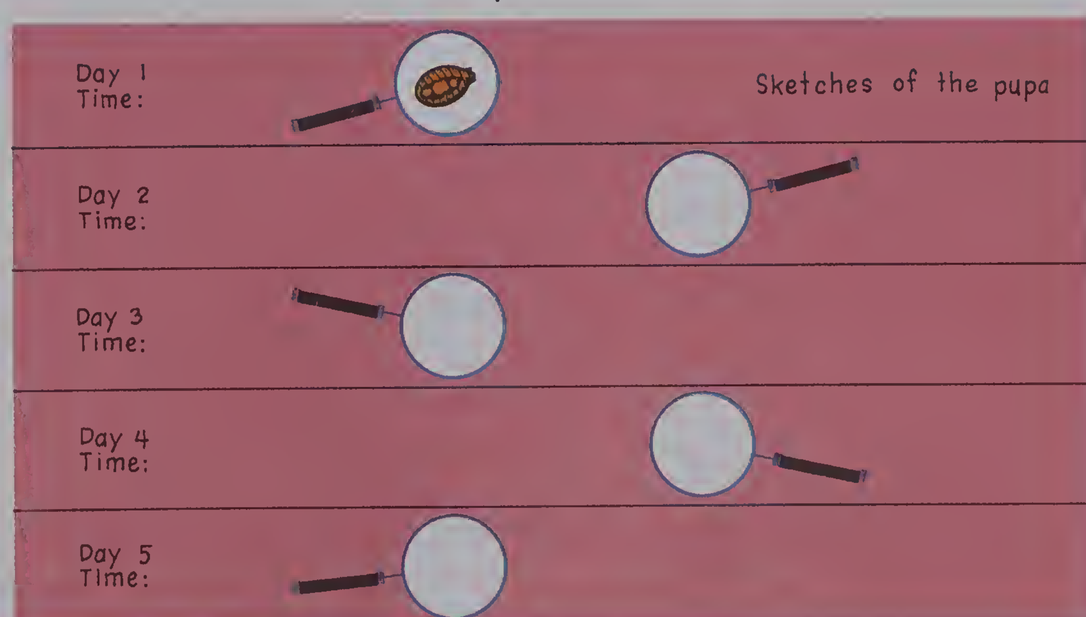
You need twenty-five mature maggots. These maggots should be in their fourth or fifth day. Any maggots that move from the plastic container of mash and fall into the larger container are old enough.
These maggots are probably ready to *pupate*. "Pupate" means to change into a *pupa*. You will see what a pupa looks like when you do this activity.
Occasionally, a house fly may spend up to two weeks as a larva, instead of four to five days. In this case, you may have to wait that long for it to pupate.
Place the twenty-five maggots into a clean, house fly colony. (If you have forgotten how to make one, look back on page 24.)
Then, wait until several maggots pupate.

The outside covering of an insect that has pupated is called a pupa case.
Every day, take one pupa case from the colony. Use a razor blade, and carefully cut the pupa case open, so that you can remove the outside layer. The first time for cutting should be when the pupa case becomes reddish in color. The pupa can be seen inside. Look at what is inside, using a hand magnifier. Make a sketch of what you see.
Cut open another pupa case each day at the same hour. Do you notice any changes inside the pupa case?
Make daily records of what you see in a chart like the one shown.

Save the rest of your colony without adding or subtracting any flies or pupae,

What safety precautions should you take when using a razor blade?

A hand magnifier can be sketched around each drawing. It shows that the pupa was seen through a hand magnifier.



so that it can be used for the activities that follow.

Digging Deeper

How many days did your observations and record-keeping continue?

Study your sketches, and list the most interesting changes that occurred to the pupa.

On which day did you first notice the pupa moving in its case?

On which day was the body of the new fly clearly seen?

Were the new flies from the pupa cases that you opened on the fifth, sixth, and seventh days able to stay alive?

How do new flies manage to escape from the pupa cases on their own? Study the empty cases to find out.

''The pupa's life is one of rest.'' Do you agree or disagree? Explain your answer.

Branching Out

How much time does a fly spend as a pupa? If the temperature were warmer or colder, how long would the fly be in its pupa case?

Using three containers, plan an experiment to help you find the answers.

Can you keep the following factors the same or identical:

(a) the containers for the pupae,
(b) the number of pupae in each container (at least twenty-five),
(c) the age of the pupae,

Each picture shows a container with pupae in it. What factor is different for each container?

(d) the amount of light received by each container,
(e) the amount of moisture in each container?

Now, decide how your experiment should be done. Try to be as 'fair' as possible. How will you find out the temperatures in the three containers?

Decide how you will write down the differences you notice in the three containers.

Will all the pupae in the three containers become new flies? Explain.

Should you stand up and exclaim: ''It's not 'fair'!''? Explain.

What other questions do you have? Can you do a 'fair' experiment to answer any of your questions?

Activity 6:

How do different foods affect the number of eggs a house fly lays?

In this activity you will compare how many eggs are laid by two groups of flies. One group should be fed on one food; the other group on a different food. The different types of food should be the only difference between the two groups.

If you have kept the fly colony from Activity 5, you already have several flies. Add just enough flies to make a total of twenty-five for this colony. Feed them water in one container and powdered milk in another container.

Set up a second fly colony in exactly the same way. However, put sugar, instead of powdered milk, in the food container.

The following things should remain the same in both fly colonies:

(a) the size of the cage;

(b) the total number of house flies (twenty-five in each cage), the number of female flies and the number of male flies;

(c) the amount of water;

(d) the amount of food, although the type of food is different;

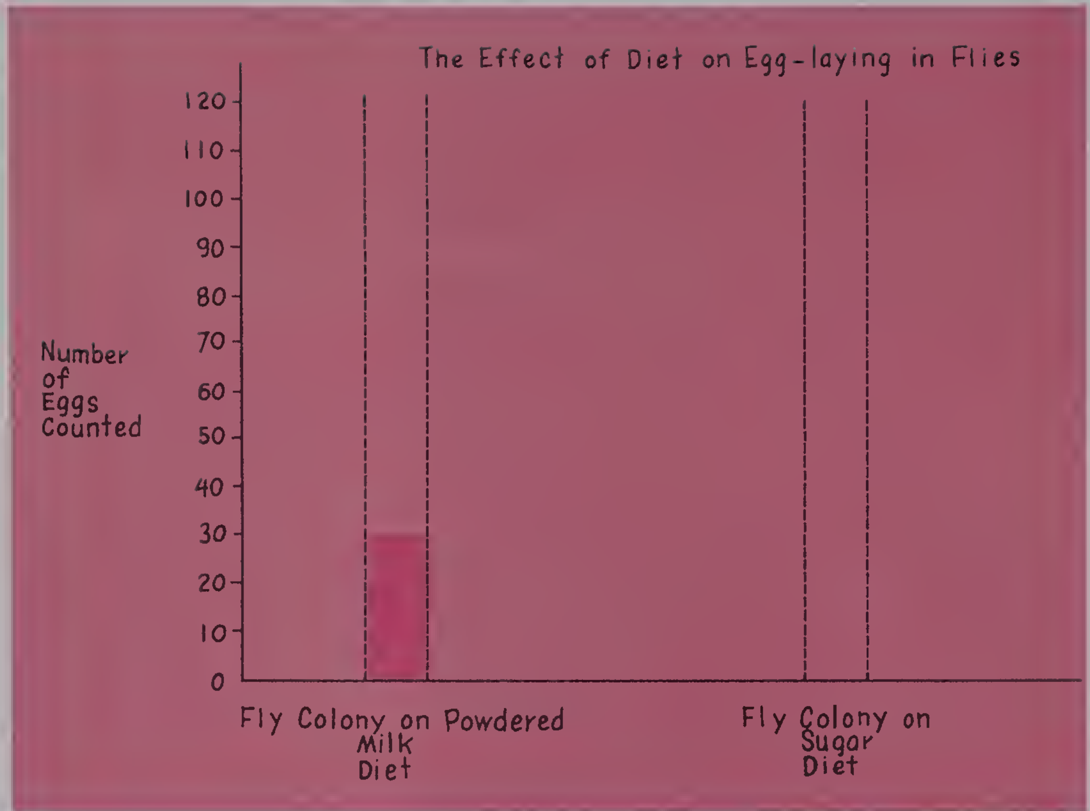
(e) the location of the cages (in the shade);

(f) the age of the flies and their previous diet; all flies in both containers should be newly hatched from pupae in the classroom.

When both cages are set up, you are ready to proceed. Prepare a bran-milk mash to serve as an egg-laying material, as in Activity 2. Place the same amount of this material into each of the colonies. Take the containers of bran-milk mash out of the fly colonies after one day. Count the number of eggs that you can see with the help of a magnifier. Write down these numbers. Prepare new batches of egg-laying material for the colonies each day. Count the eggs each day for five days.

How many eggs were laid in all by each group of flies?

Complete a graph like the one shown.



How much of each bar in the graph should be filled in solidly?

Digging Deeper

Study your graph. What does the information on the graph tell you?

How long did it take for the young flies fed on powdered milk to lay eggs?

Was this a 'fair' experiment? Explain. What factor was difficult to keep the same for both colonies?

What other foods could you use in an experiment like this one?

Branching Out

Choose one of the *What would happen if . . . ?* questions, and do a 'fair' experiment with your adult house flies to answer the question.

(a) *What would happen if* you changed the air in a house fly colony?
Put a small container of vinegar in the cage, and drop an Alka-Seltzer tablet into it. This is one way to make carbon dioxide. Carbon dioxide is one of the gases that all animals breathe out.

(b) *What would happen if you* separated the male house flies from the female house flies as soon as they were hatched from the pupa cases?

(c) *What would happen if* you sprayed the bodies of house flies with different kinds of insecticides, pesticides, or weed killers?

What other questions can you add to this list for your investigation?

PLANNING AN EXPERIMENT

Here are some questions to guide you in planning and understanding an experiment:

What is the question?
Write your problem in the form of a question. The question should be as clear as possible. Read carefully the question that you are going to try to answer. Try to understand exactly what it means.

How are you going to measure?
Some different ways of measuring are counting, weighing, and timing. Sometimes you have to watch very carefully instead of measuring. Decide whether you can just watch what happens or not. If you are going to take measurements, how can this be done?

How can you record your observations?
Remember to write down any helpful information. Repeat the experiment several times to be more certain of what you see. Organize your results in a chart, a diagram, a note, or some other suitable kind of record.

What does it all mean?
After you have completed your experiment, and collected your information, you should study your data. How does it answer your question? Would taking an average be useful? Was your activity 'fair'? Was it a controlled experiment? If you do not have a definite answer to the question that you chose, you might want to try the experiment again in a different way.

Which picture shows the house fly egg? The maggot? The pupa? The adult?

Activity 7:

What is the life cycle of the common house fly?

Small creatures go through several changes during their lifetimes. You have seen remarkable changes in the appearance of your house flies as they changed from eggs into adults.

Do you recognize the *stages* shown in the pictures?

What are the names of these different forms of the house fly? In what order do the stages appear?

Study the diagram showing a life cycle with four stages.

Make a list of other insects that go through these four stages.

Digging Deeper

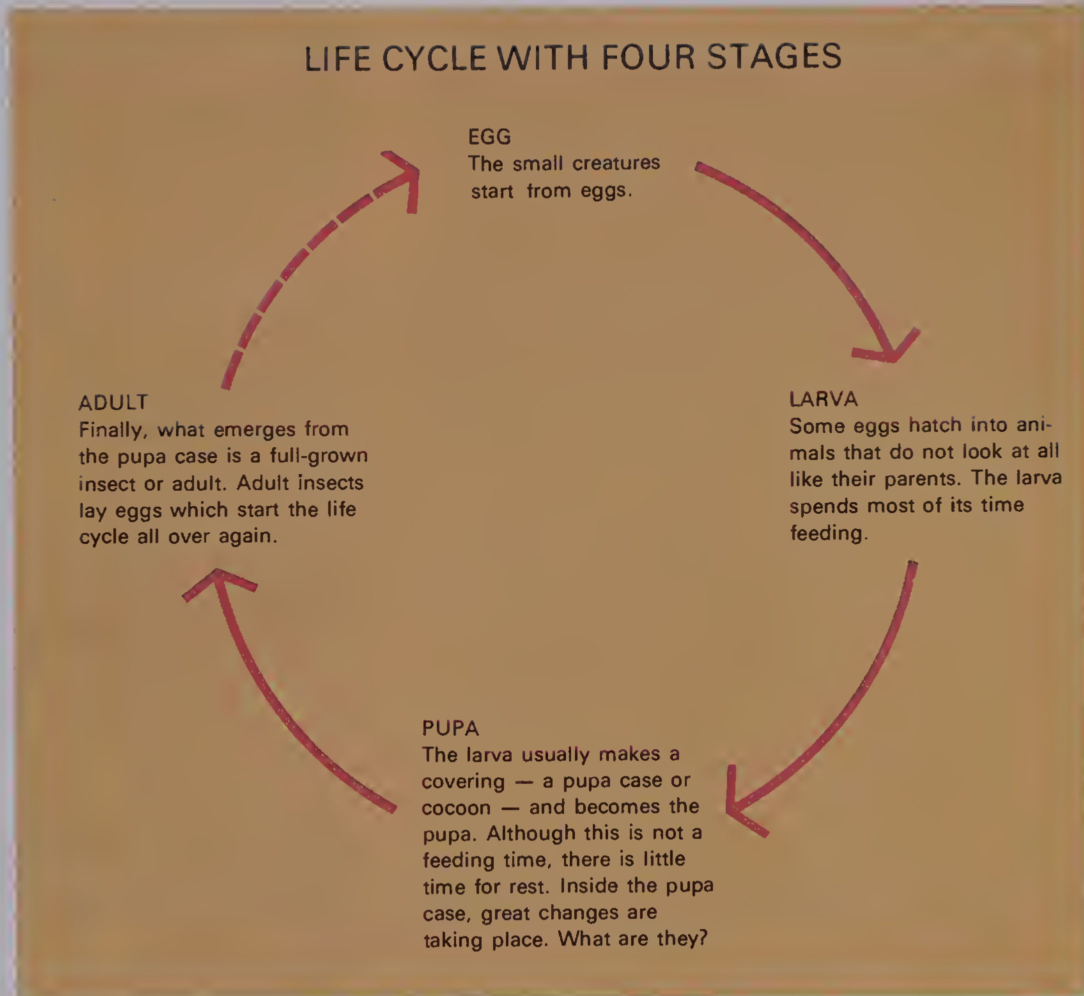
Why are the changes in the lifetime of an insect called its *life cycle?*

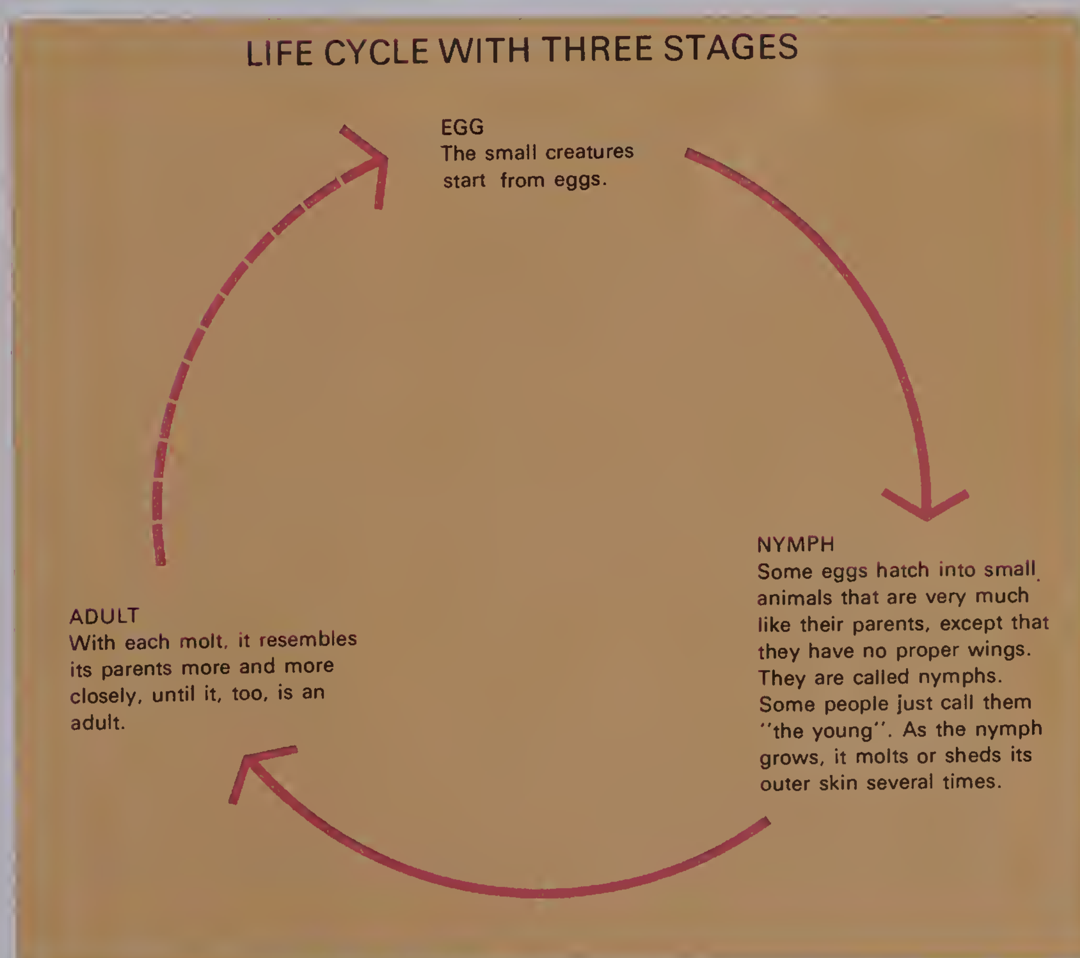
"Before pupating, a maggot goes through two changes." Try to recall your activities with maggots. Do you agree with the statement? Why?

What kinds of changes do human beings go through before becoming adults?

Branching Out

Study the life cycle chart showing a life cycle with three stages. Many insects have this kind of life cycle. Try to find out which types of insects, and make a list of them.





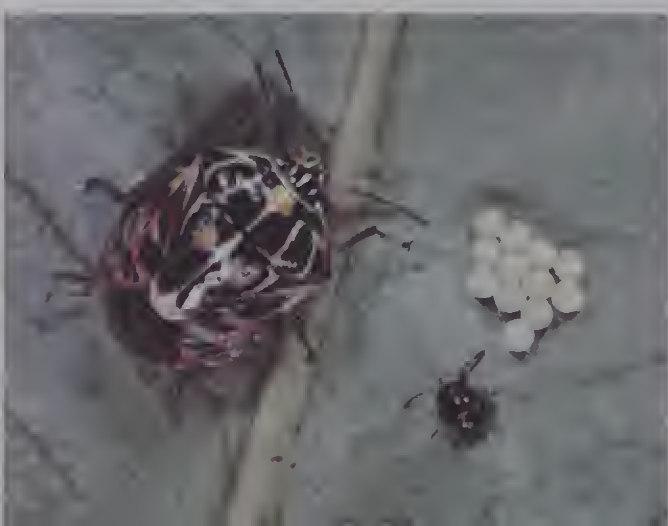
The above photograph does not show a spider. It is the spider's molted skin!

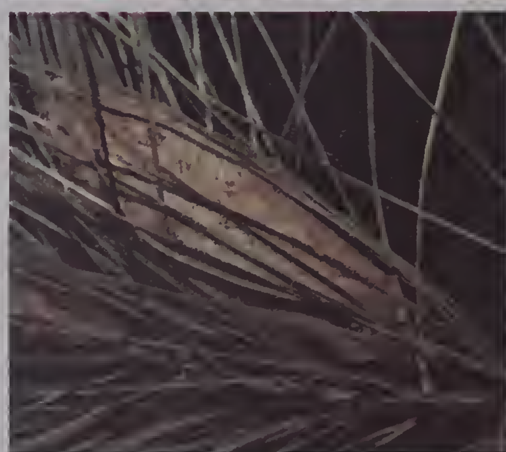
When spiders hatch from eggs, they are very small. As they grow older, they become larger. When their ''skin'' is too small, they *molt* or shed their skin. Underneath, a new, more elastic skin has grown. This new skin hardens when it is exposed to the air. This process is repeated many times during the spider's life.

Other small creatures also look just like miniature adults when they hatch. But they do not shed their skins as they grow. How do these kinds of creatures grow?

Use books from the library to find out the life cycles of other small creatures that you collected while doing the activities in Chapter 1.

Look at the pictures of other small creatures shown here. How many changes must each go through to become an adult?





Creatures Underfoot

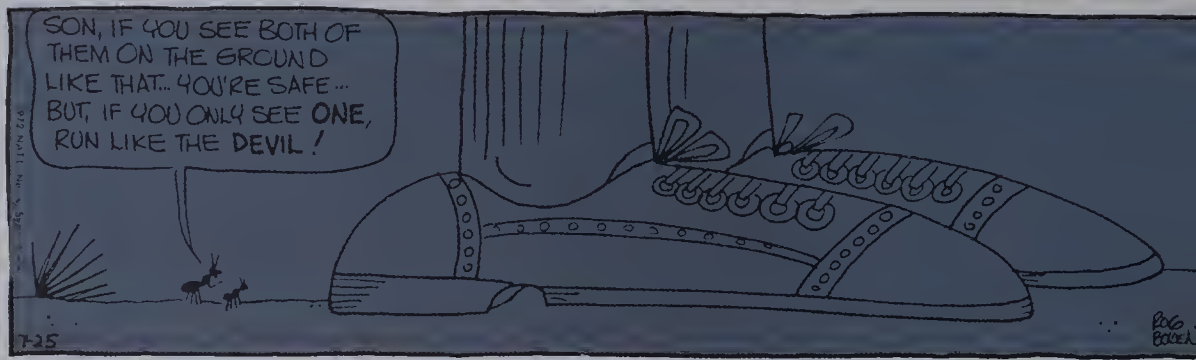
3. Creatures Underfoot

Suppose your front yard had a see-through covering. What if you could see through the soil particles, rocks, and plant roots under the ground? You would be able to see right into the living rooms of thousands of creatures!

Those animals that burrow into the ground but search on the surface for their food, such as ground hogs and chipmunks, may be the first animals that come to your mind. These animals are giants compared to some other creatures that live underground!

Have you ever hunted for worms to use as fishing *bait*? Who hasn't watched the busy activity around an ant hill? These small creatures are easily seen with the naked eye, but many even smaller creatures, not so easily seen, also live in underground homes. Thousands of tiny animals can be seen only with the help of a microscope.

Just think — outdoors, a whole zoo of creatures might be found hidden under each footstep!



Activity 1:

Where can you find small soil animals?

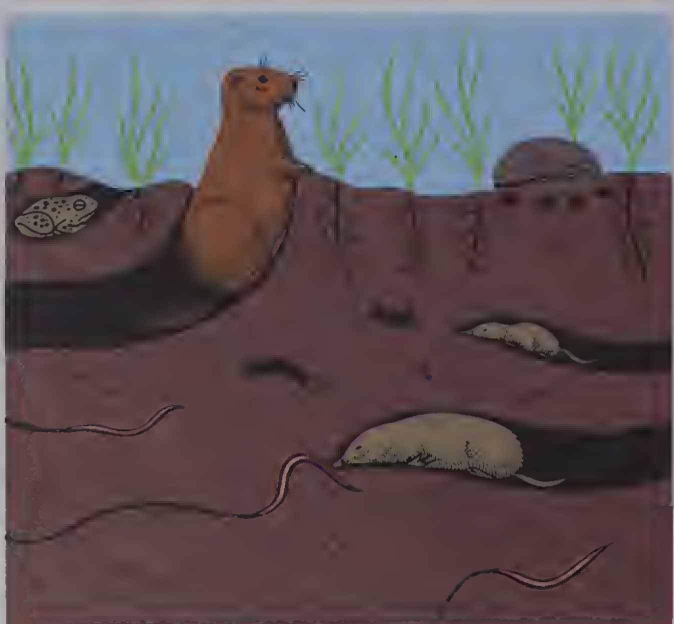
Take a walk around your school or neighborhood. During your short field trip, try to uncover homes of underground creatures from a garden, a lawn, a vacant lot, or a field.

To collect small creatures, you need several plastic pill vials or similar containers. Place a bit of moist paper towelling in the vials, to keep the inside of the containers damp for the soil creatures that you capture.

Attach a piece of masking tape to each container. Using a pencil, you can record on the tape the place where you found each animal.

You might use homemade tweezers for picking up your ''creepy crawlers''. Start by turning over a flat rock or board. That rock or board acts as the

How are people a threat to small creatures underfoot?



roof of a house under which many animals live.

As you collect specimens, work quickly, since these animals have their own back doors, through which they leave as soon as you disturb them. If you are using tweezers, be careful not to squeeze the creatures too tightly when you pick them up.

Find a garden trowel. This is like a small shovel, but it has a short handle. A garden trowel is usually used for gardening.

With a garden trowel, you can find small creatures a second way. Locate a grassy area or a place with some rich garden soil. Many soil creatures can be found in the top 5 to 10 cm of the surface. Kneel down, and lift the earth with the garden trowel. By carefully separating the soil litter or particles with your fingers, you will come across many small creatures.

Watch for the creatures with an observant eye, since many animals are very quick. Some are camouflaged by their coloring, so that it is difficult to see them. Others are difficult to spot because they are so small. Again, for each type of small creature, collect one and count the number you leave behind.

Also try another method of collecting small creatures. First, dig a shovelful of soil, and place the soil on a newspaper spread out on the ground. Then, look through the soil particles, as before, to find the small animals. Continue collecting a specimen of each type of small creature that you find. Then count the others of the same type.

Digging Deeper

How many different types of small creatures did you find?

Which method of finding small creatures was most successful?

In which area did you find the most small creatures?

Do you think that you found all the small creatures in each area? Explain.

Was any type of animal found in more than one area? Explain your answer.

Did you find most of the animals in damp soil or dry soil?

How would you describe the places where your soil creatures lived?

Would you say these places were light or dark? Damp or dry? Were their homes hidden or easily seen?

Branching Out

How many of the animals that you collected can you name? Use the key in Chapter 1 to help you identify the creatures that you cannot name.

Another way to identify small creatures is to use picture keys that you may find in your school or public library.

Go to your library and borrow books on insects and other soil animals to find out how they are able to live underground. Your answer might include the following words: *food, protection, moisture, light,* and *decay.*

You may have found clues that told you some small creatures were nearby, even though you did not find the animals. Examine the photographs, and use books to answer the questions that go with them.

If you have caught live specimens, you might do one of two things with them: You might return them to the places you found them or to similar places.

Or, if you wish to keep them for later activities, you can make cages for them. The cages should copy their homes in nature as much as possible.

Activity 2:

In what special ways can you collect small creatures underfoot?

Hunting small creatures can be a lot of fun. This activity suggests three new ways to collect small creatures. Read the methods carefully, and decide which ones you would like to try. Once you have decided, gather the necessary materials together. Follow the diagrams and instructions to help you build and use the traps.

Trails made by a slug. How are these trails made?

This is called an earthworm casting. What is it? How is it made?

What evidence of small creatures' homes did you find?

METHOD 1. USING A SEPARATOR

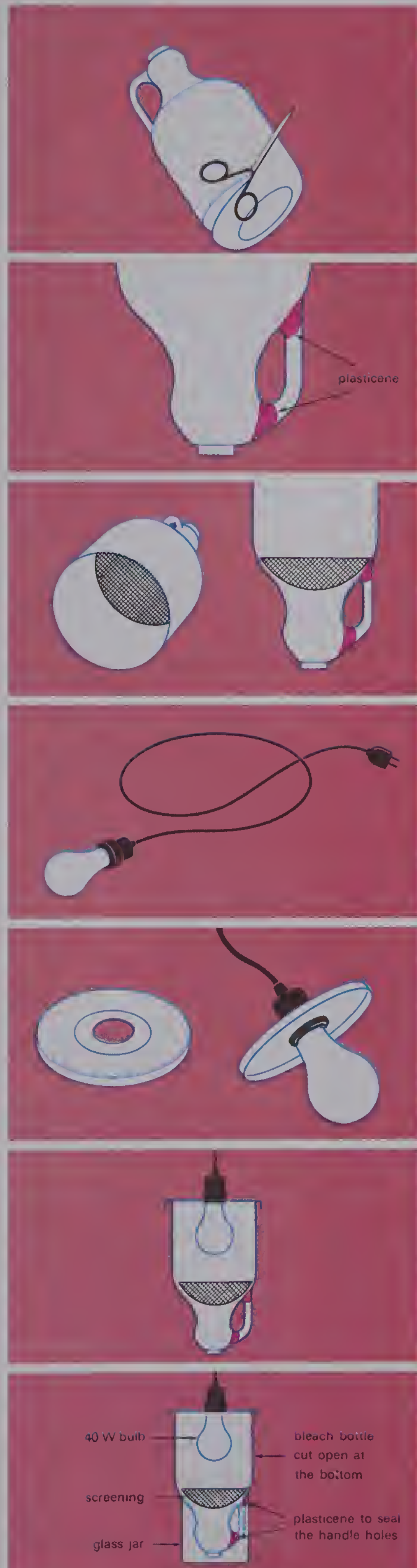
First, make the separator as shown in the diagrams. After you have made the separator, here are some suggestions for using it:

Visit several areas to collect *soil litter*. You might try gathering soil litter from a grassy lawn, a garden, a forest floor, a field with tall grass and weeds, and the bank of a stream.

Scoop up the soil litter with a garden trowel. Place each sample of soil litter in a plastic sandwich bag. Seal the bag, and on it, put a label that names the place where you found the soil litter.

In your classroom or at home, carefully place the soil litter from one of the bags on the hardware cloth inside the separator. Try to avoid losing any of the soil litter through the screening.

Cover the separator with the ice cream lid, and turn on the light. Notice what happens in the collecting jar. Place each "creepy crawler" in a separate pill vial or small jar. Don't forget to label each container.



"Creepy Crawler" Separator

HOW TO MAKE A "CREEPY CRAWLER" SEPARATOR

A. Obtain an empty plastic bleach container. (About 1.5ℓ is a suitable size.) Use scissors to cut the bottom out of the container.

B. Plug the inside handle holes with plasticene. Unscrew the bottle cap and leave it off.

C. Cut a piece of hardware cloth of 1 cm mesh to fit inside the container. Hardware cloth is a type of screening that is inexpensive and available at most hardware stores.

D. Try to obtain an extension cord with a light socket. If you cannot find one, ask an adult to help you wire a pigtail socket or other light socket to an electrical cord. Place a 40 W bulb in the socket.

E. Obtain the lid from a plastic ice-cream container about 0.5ℓ in size. Cut a hole in the lid so that the socket will fit tightly.

F. Place the lid and socket over the bottom of the open plastic bleach bottle.

G. A glass jar or similar container placed below the neck of the plastic bottle completes your separator.

METHOD 2. USING A GROUND TRAP

Make several ground traps by following the instructions in the diagrams. Place them in different parts of your school or neighborhood. Do not choose spots that might be disturbed by larger animals or other children. Leave the ground traps overnight.

When you dig up the traps, label the jars with the place each one was set. Fill in the holes that you dug in the ground. Return to your classroom, and put the creatures into pill vials with proper labels.

HOW TO MAKE A GROUND TRAP

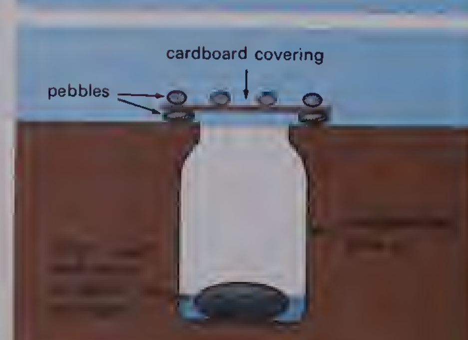
A. Get a straight-sided glass jar with a wide, open mouth, such as a jam or peanut-butter jar. Cover the bottom of the jar with about 2 cm of water and sweeten the water with 10 ml of sugar.

B. To this add two drops of liquid detergent to make the bottom of the jar all the more slippery, so that any animals that fall into the jar will not be able to crawl out.

C. Dig a hole in the ground with a garden trowel.

D. Place the jar in the hole so that the mouth is even with the surface of the ground. Pack extra soil around the jar to hold it firmly. Save the rest of the soil in a box. You can use it later to fill in the hole, after you have finished using your ground trap. Place a flat rock in the center of the jar so that animals which are caught in the trap can crawl onto the rock to avoid drowning.

E. Cut a piece of cardboard into a circle wider than the mouth of the jar.



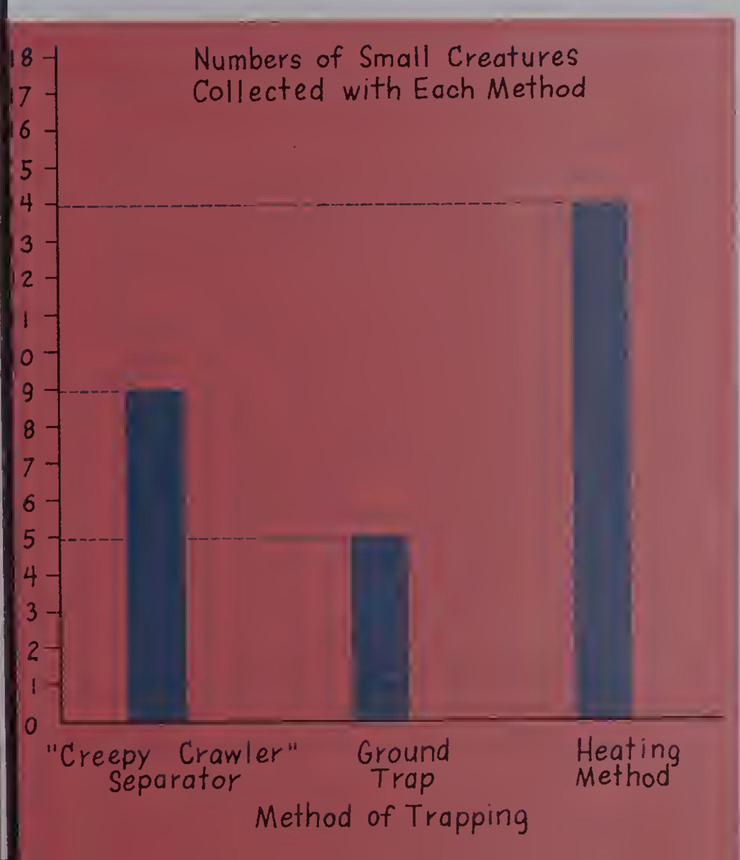
F. Arrange four pebbles around the mouth of the jar. Place the piece of cardboard on top of them, so that the mouth is covered. The pebbles should raise the cardboard covering about two centimetres above the surface of the ground. Put some small stones on top of the cover to hold it securely. Your trap is complete.

METHOD 3. USING HEAT

Use a shovel to dig up some soil from several different places in your neighborhood or near your school. Place each shovelful in a plastic bag, and label the bag.

At home or in school, place what is in one of the bags on an aluminum foil plate. Heat this gently on a stove or hot plate. Watch what comes out of the soil. Collect the small creatures, and place them in pill vials.

Remember to label the containers. Repeat the activity for each shovelful of soil.



How do small creatures react to heat?

Count the small creatures that you collected with each method, and show your findings on a graph like the one shown. If you did not use all three methods, perhaps classmates who did can add their findings to the graph.

Digging Deeper

Which method helped you find the most creatures?

Which method helped you find the greatest number of different types of small animals?

From the results recorded on your graph, would it be 'fair' to say that one method is better than the others for collecting the largest number of creatures? Was everything except the method of trapping kept the same? Did you use different kinds of traps in the same places? Did you use each method for the same length of time? If anything was not kept the same for every method, can you expect one method to be better every time?

A graph is sometimes a useful way to show your findings. In what other ways could you show your data?

Which areas around your home or school had the largest numbers of small creatures? How would you describe these areas? Do they have much light? Moisture? Food?

From what you have seen, in what kinds of places do small creatures prefer to live?

Which animals could you not name? How could you find out their names?



Which photograph shows a study area that resembles yours?

Activity 3:

How many small creatures live under patio or sidewalk stones?

For this activity, you need a suitable patio or sidewalk. Find one with slabs of equal size which are easy to lift. Your school might have such a sidewalk, or you might try a neighbor's patio.

When you find a suitable study area, ask the owner for permission to use it. Explain why you need the sidewalk or patio, and what you plan to do. You should promise to leave the concrete slabs exactly as you found them. Of course, make sure you keep your promise!

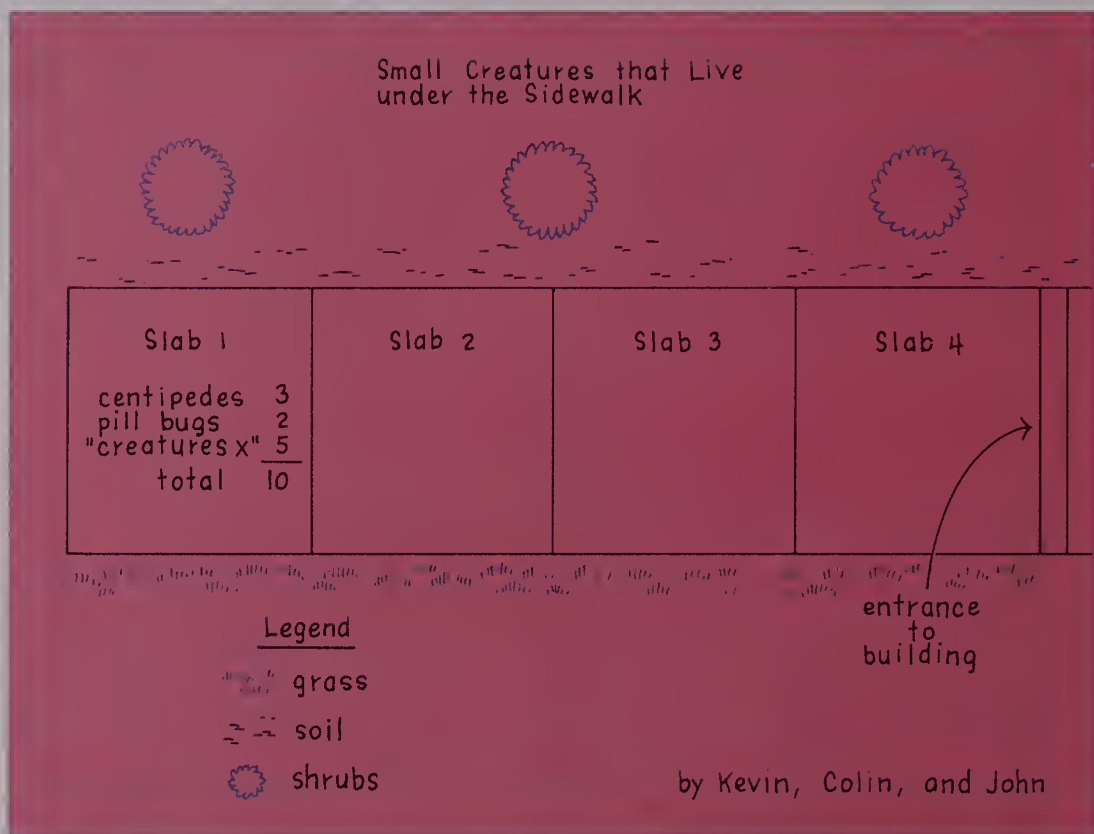
Make a map showing the position of each of the slabs in your study area. Place this map on a clipboard or in the notebook in which you record your data.

Carefully lift the first slab. Count the numbers of each type of small creature that you can see on the underside of the cement and the ground below.

On your map, show the numbers of each type of animal that you found. Your partially completed map might look like the one shown.

If you don't know the name of a creature, make up a name for it. For example, you might call it "Creature X". As soon as you have a chance, identify it using the key in Chapter 1.

Repeat the activity for each slab of patio or sidewalk. Don't forget to write down what you see as you go along.



Digging Deeper

How many small creatures did you find under all the slabs? Under which slab did you find the greatest number? The fewest?

How many different types of creatures did you find?

Why do you think that there were more of one type than of others?

Some of the creatures that you found probably feed on decaying plant material, while others feed on other small creatures. How could this affect the number of any type of small creature that you found?

What do you think would happen if there were too many creatures under one slab?

Do you think that all the animals living under each slab were included in your count? Explain your answer.

Branching Out

How many small creatures are able to live under one sidewalk slab? Collect as many underground creatures as you can. You might use small jars or pill vials to collect them. Count all the small creatures and the number of each type.

Now, choose one slab that is easy for you to lift. Lift this slab, and let all the creatures that you have collected go free on the uncovered soil. After a few minutes, put the cement slab back in place.

With long pieces of masking tape, put an identifying sign on the slab. Return to the same slab each day for one week.

What might you expect to find under a sidewalk slab?

Try to visit at the same time every day. Lift the slab, and count the number of small creatures and the number of each type.

Did the number of creatures under the slab change during the week? Did it stay the same? Can you explain any changes?

Did you find any clues that made you think some animals died?

Find out what *over-populated* means. Why isn't the soil under all the slabs over-populated?

Do you think that by lifting the concrete slabs every day, you may have changed the numbers of creatures underneath?

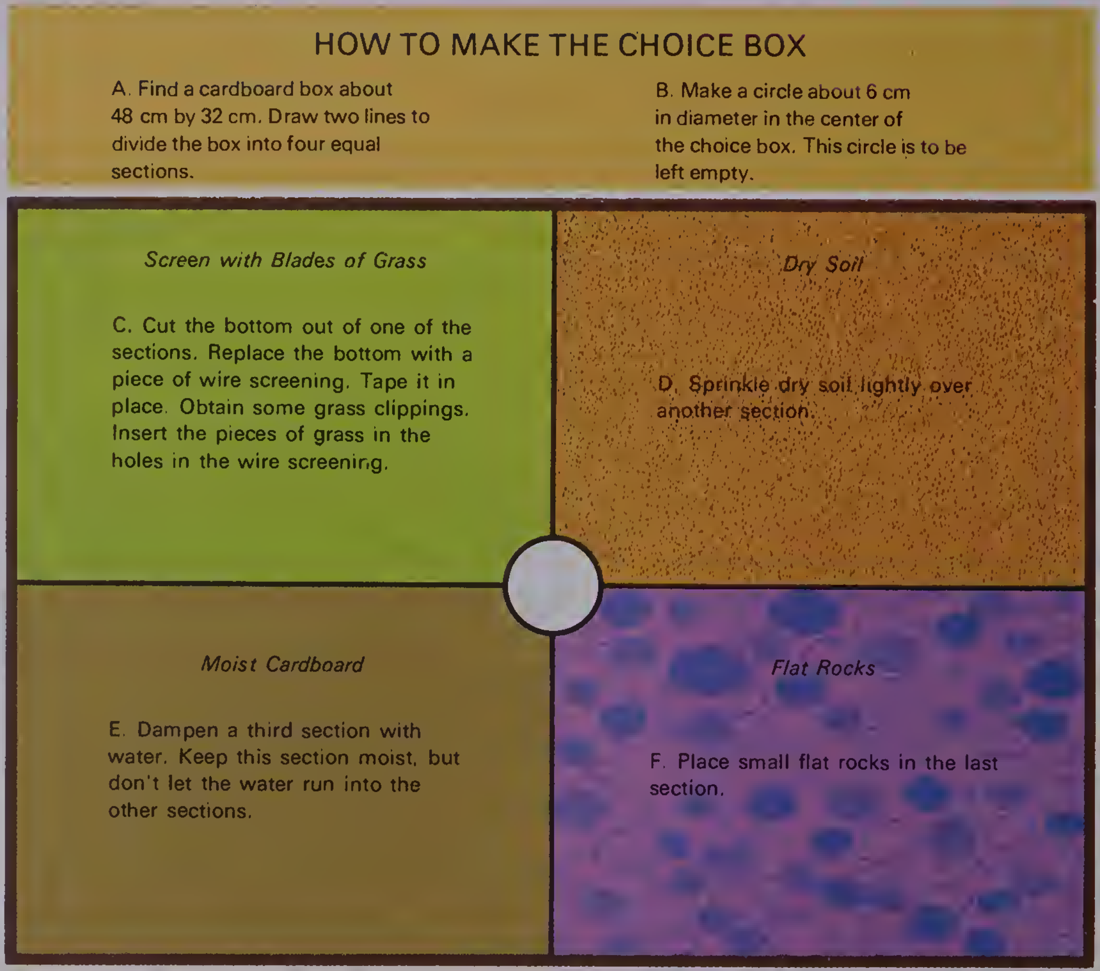
Terry and Elaine are showing their neighbor the results of the activity, and they are thanking her for the use of her sidewalk.

Activity 4:

What type of place do pill bugs prefer?

To do this activity you need to get ten pill bugs. If you cannot find pill bugs, use millipedes or centipedes. Many small creatures can live only in a special type of place. If they cannot find these places, they die. A pill bug is this type of animal.

You probably have found some pill bugs already. Think of the places where you found them. What places do you think are suited to pill bugs? Write down the following items, and order them from one to four by placing a "1" beside the most important, a "2" beside the next



When this chart is completed, where do you think most of the pill bugs will be found?

most important, a "3" beside a less important item, and a "4" beside the least important.

___plant material

___dry soil

___moisture

___hiding places

Let's see if you turn out to be right.

Set up a choice box. You need a rectangular cardboard shirt or dress box. Make the choice box as shown in the diagram.

Place ten pill bugs in the center section of your choice box.

After a few minutes, look in the choice box for the ten pill bugs. If any managed to crawl out of the choice box, put them back in the center again.

Count the number of pill bugs in each area. Draw a diagram of the choice box, showing where you found the pill bugs.

Digging Deeper

Which section had the most pill bugs? The least?

Why do you think the pill bugs chose the sections in which you found them?

Were your guesses correct about what was important to the pill bugs?

What evidence could you find that the pill bugs had wandered around before settling in one section?

How would you set up an experiment to find out the second most preferred condition for your pill bugs?

Do you think a pill bug knows exactly where it is going? Explain.

How do you think it is able to find the places where it can survive?

Name five places where you have not looked but where you might expect to find pill bugs.

Time it Takes an Earthworm to Move from Different Surfaces

	Test 1	Test 2	Test 3	Test 4	Test 5	Average Time
Bare Surface						
Vaseline						
Water						
Sandpaper						
Cooking Oil						

Activity 7:

On what kind of surface does an earthworm move fastest?

Earthworms are familiar creatures that live underfoot.

Collect several earthworms for this activity. You might dig with a shovel in a garden to find them. What other ways of catching earthworms do you know? Keep the earthworms in a shoe box with moist (but not wet) earth.

Use a hard, smooth surface such as a desk top, a piece of glass, or a surface of plastic or wood. Find several types of materials which can be used to cover the surface. You might collect a jar of Vaseline, a glass of water, a sheet of sandpaper, a vial of cooking oil, and so on. Of course, choose things that won't be harmful to the earthworm.

Place an earthworm on the bare surface. Watch how it moves. Mark a circle on the surface around the earthworm. Use a watch or clock with a sweep-second hand to time how long it takes for the worm's tail to pass the mark on the surface.

Do this timing five times, and find the *average*. (Add the five measurements together and divide the sum by five.)

It is important to allow your earthworm to rest after you test it five times on the bare surface. Put the worm in a box by itself for fifteen minutes. The box should contain some moist material, such as a damp paper towel.

Repeat the activity with the same worm, but this time smear a thick layer of Vaseline (or other substance) inside your circle. Time your worm again, and take an average. Record your findings.

Clean the surface, and use the other materials that you have collected to test the movement of the worm again. If you need to draw your circle again, make it the same size every time. Try to give your worm the same amount of resting time between each set of five tests.

Digging Deeper

On which surface did the worm move fastest? Slowest?

Which surfaces were rough? Which ones were slippery?

How would you describe the movement of an earthworm?

Why do you think that the earthworm moved faster on some surfaces than on others?

What factors were kept the same in this activity?

How was the distance that the earthworm moved kept the same for every test?

What factor changed during the activity?

Why was it suggested to try the worm on each surface five times and then to find an average?

Branching Out

Have a worm race!
Each student should choose an earthworm.
Can you guess how fast your earthworm travels by first watching it in its home? Does the length of the earthworm affect the speed at which it can travel?

Together with your classmates, decide the rules for the race, the place for the race, and the best way of finding a winner.

After a rain shower, go for a walk around your school grounds. Count the number of earthworms that you find. Keep a tally showing where you found the worms. Repeat the activity in the same areas after a full day without rain. If you were looking for earthworms again, when would you choose to go looking? Where would you look?

When and Where Can Earthworms be Found?

	Sidewalk	Puddles	Grass	Garden	Total
Right after a rain shower	~~////~~ /				
After a full day without rain	//				

Bootleg worm-pickers prowling Metro lawns

Members of a huge underground society are being illegally dragged from their Metro hideouts every night by an army of phantom prowlers, police confirmed today.

The victims, Metro's most down-to-earth residents, are then being sold into captivity which ends in certain death.

Homeowners, civic officials, and police say they really don't care about the victims, but they're pretty peeved at the abductors.

Maybe that's because the victims are only earthworms, while the abductors belong to an army of worm-pickers trampling homeowners' lawns, gardens and shrubs.

Rudy Tresnak of Lowther Ave., in the Bloor St. W.-Spadina Rd. area, saw them at work the other night when a squad of phantom-like figures swooped down on his lawn wearing illuminated miners' helmets, and tin cans strapped to their legs.

"At first I wondered who was grabbing at my lawn," he said. "Then I saw they were moving all along the street, picking at everybody's lawn."

Police confirmed they've had frequent calls from homeowners this summer, particularly in lush-lawned Forest Hill, asking them to shoo the trespassers off their property.

Bob Conroy, a bait dealer who pays $40 000 a year for licenses to pick worms from 16 Metro-area golf courses, says there are about 300 "bootleg" pickers prowling Metro's residential neighborhoods from April to October.

He says they're selling their booty to some fishing bait dealers for $9 per 1 000 worms, and estimates an experienced picker who can grab 1 000 worms an hour can earn $250 a week this way.

Still, there's no danger of Toronto lawns being rendered wormless, Conroy says.

He estimates each hectare of lawn contains 27 million worms.

How can an earthworm home be made? Follow the instructions in the diagram for an earthworm home.

Make layers of each soil type in the jar about three centimetres deep. Make sure the soil is layered, not mixed.

Mark the boundaries of the layers on the outside of the jar with a felt pen. Make a drawing of the jar with its separate layers.

Place up to twenty worms in your home, and cover the top with the wire screen. Moisten the soil surface, and place some oatmeal, cornmeal, or coffee grounds on the soil each day. Remember the size of the worms when you decide how much to feed them.

Whenever possible, watch your worms by removing the black paper. Water the soil from time to time, to keep it moist. If anything you see makes you wonder about the behavior of earthworms, plan an experiment to answer your question.

Do you agree that earthworms are good soil cultivators?

Why do people pick earthworms?

What is a *bootleg worm-picker?*

Why do people get upset by worm-pickers on their property?

From the figures in this article can you find out how much money a worm-picker gets for each earthworm?

How do you think worm-pickers are able to find so many earthworms?

Why are tin cans strapped to the worm-pickers' legs?

In worm-picking, what is the purpose of the miners' helmets?

Why would worm-picking be a very difficult job?

Why do you think a bait dealer would pay $40 000 a year to be able to pick worms on the golf courses?

The last two paragraphs suggest that worm-picking is not likely to leave city lawns with a shortage of worms. Do you agree? Explain.

Interview a bait dealer if you have questions about worm-picking that puzzle you.

On the Wing 4

4. On the Wing

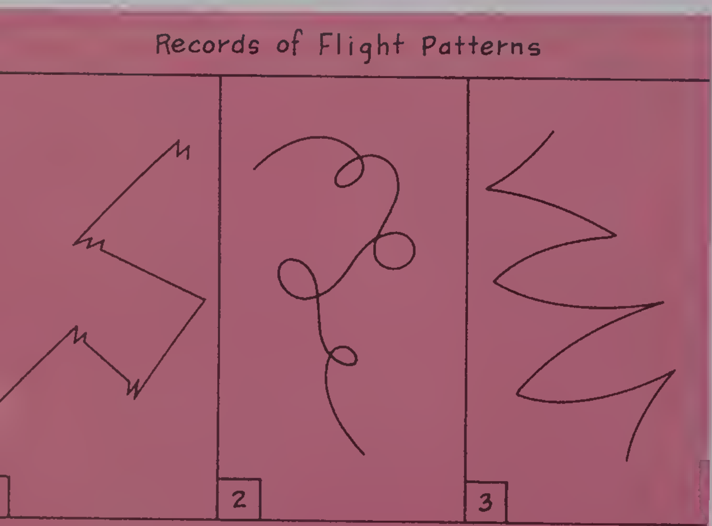
Small creatures that fly are familiar to most people. Perhaps you have been bothered by creatures flying about you because they buzz and hover and dart. Have you ever enjoyed watching their graceful flight and brilliant colors from a distance? Whether they are pests or objects of beauty, flying insects — which make up a very large number of the animals in the animal kingdom — are interesting to study.

Are all the creatures you see in flight insects? Explain your answer.

The wings of insects appear only when they become adults. Can all adult insects fly?

Many types of wings are found on adult insects. Study the photographs, and describe the shape and the position of the wings. Do the wings fold up, or can they only stick straight out? Do they slant forwards or backwards? Are they wide and round, or long and slender?

Insect wings may have many different shapes, colors, and sizes. Flight patterns can also be different for these small creatures.



What small creatures could these flight patterns represent?

Go outdoors with a clipboard, paper, and a pencil to a green area, and sit quietly for fifteen or twenty minutes. Watch for any small creature that is flying. Notice its flight pattern. Sketch the flight pattern on your paper. How many different patterns do you notice in the flying insects around you?

Activity 1:

How can small winged creatures be caught?

Before you can learn much more about flying insects, you should have some more live specimens to study.

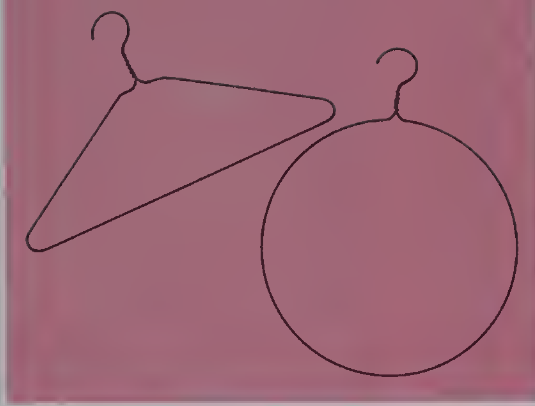
This activity has three parts. Each part suggests a different way to collect small creatures.

You might wish to try all the methods, or you may prefer to choose just one or two methods that seem most suitable for your needs and available materials.

Perhaps you know of other ways of catching small creatures on the wing. You might try those methods, too.

After you have captured the insects, remember that you have removed them from their homes. If you want your animal to stay alive, put it in a cage which is like the place in which you found it. See Activity 2, and select the proper cages to make for the types of specimens that you have collected. The specimens should be placed in their classroom homes as soon as possible after they have been collected.

HOW TO MAKE A SWEEP NET

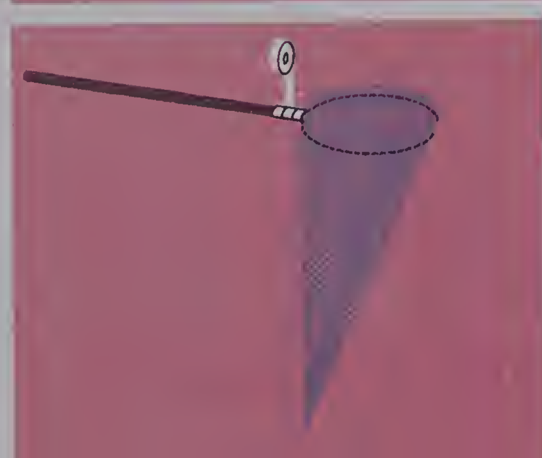


A. Bend a wire coat hanger into a round shape.

B. Get a one-metre length of nylon netting or cheesecloth. Cut the netting into a large triangle as shown. The two sides of the triangle should be equal in length. The base should be long enough to fit around the round part of the coat hanger.

C. Fold the two sides into the shape of a cone, and sew along the overlap.

D. At the open end, fold the edges over the coat hanger, and sew the netting to the coat hanger.



E. Straighten the hooked end of the coat hanger, and tape it securely to the broom handle. Strong tape, such as bookbinding, electrician's, or adhesive tape, is best. When you have finished, your sweep net is ready to use.

The hunter and the hunted!

METHOD 1. USING A NET

To use the net, visit several areas around your school and neighborhood. You might try to catch winged creatures in tall grass, shrubs, and flower gardens. Also, search grassy lawns, low tree branches, wildflowers, and other weeds. When you see a likely specimen, stalk it carefully.

If you do not easily find flying insects to collect, sweep your net with a back and forth motion through the tops of tall and short grass.

Quickly trap the creature with a sweeping motion of the net. To ensure that the small creature does not escape, turn the handle so that the mouth of the net is closed. Close your hand around the top of the net sleeve, and corner the insect in the bottom of the net. Be ready with a jar or similar container in the other hand. Gently tap your specimen into the jar, and replace the lid.

Label the jar with your name, the date, the place of the insect's capture, and the method of collecting; that is, "using a net".

If several of your classmates have made sweep nets, play a game. See who can collect the most animals in fifteen minutes. When you have finished, list the difficulties you experienced in trying to capture these creatures.

METHOD 2. USING A LIGHT TRAP

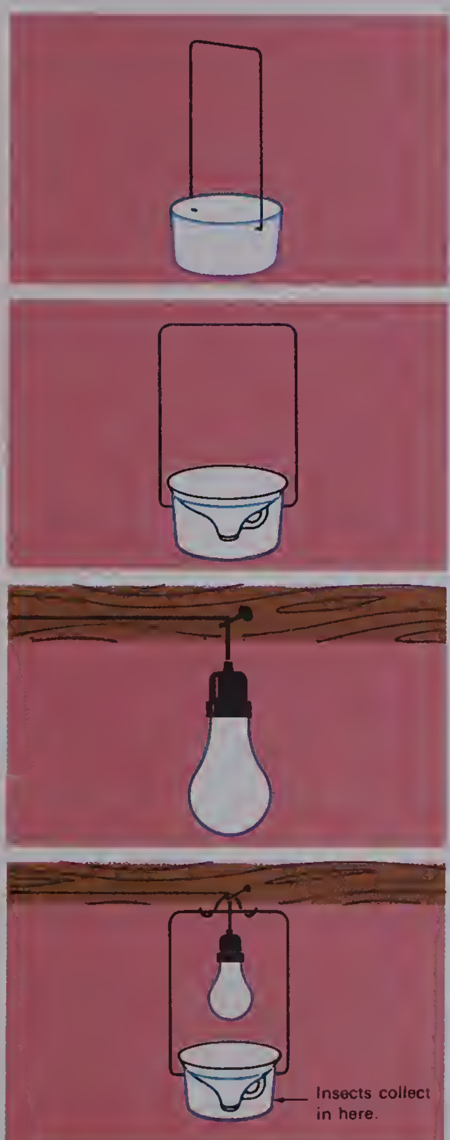
You might choose to construct and use the light trap at home, since it works best at night.

Hang the trap in a place such as a balcony, a tree, a porch, a garage, or the ledge of an upper story window. When it is dark, turn on the light for two hours.

Return to your trap, and study the insects that you have collected. If you decide to leave your trap set up overnight, examine it in the morning. Carefully place in a jar for further study each specimen you catch. Label each jar with your name, the date, the place of the insect's capture, and the method of collecting; that is, ''using a light trap''

You might also try several light traps with a differently colored light bulb in each one. What different types of small creatures are attracted to each of the lights?

You can also collect small creatures that are attracted to light by using a sweep net. Leave a porch light on at home during the evening. Catch the flying insects that gather around it.



HOW TO MAKE
A SIMPLE LIGHT TRAP

A. Get an empty plastic ice cream container. Make a long handle for it with a forty-centimetre length of lightweight wire.

B. Find a funnel which fits the mouth of the plastic container. You might use the top part of a plastic bleach bottle. Put the funnel into the container as shown.

C. Choose a socket from which to hang the light trap. It should have a 40 to 60 W bulb screwed into it.

D. With a short piece of wire, attach the wire handle of the light trap to the top of the light socket. When you are ready to use the light trap, turn on the light.

METHOD 3. USING A "POOTER" OR ASPIRATOR

Here is another way of catching small creatures alive. This method is best for very small creatures (less than one-half centimetre in length and width).

Visit several areas around your house or school where you are likely to find flying insects. Point the end of the straw at a small insect that has landed on an object such as a flower. Breathe in through the short piece of tubing, so that the insect is sucked into the pill vial.

Why do you feel safer with the piece of cheesecloth taped to the tubing in the pill vial?

To remove the insect, simply take the lid off the vial, and transfer it to another pill vial or jar. Label each container with your name, the date, the place of the insect's capture, and the method of collecting; that is, "using a pooter".

Digging Deeper

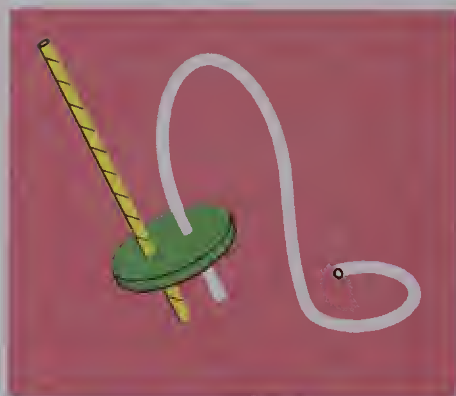
How many of the methods did you or your classmates try?

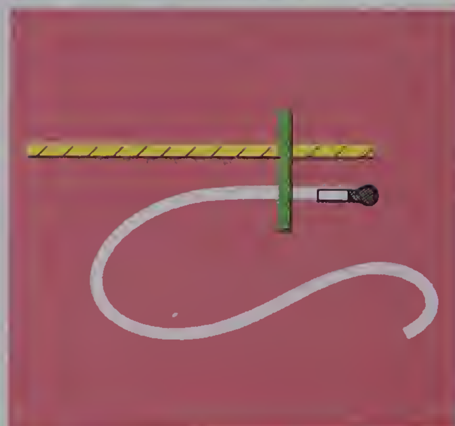
Which method did you find most successful?

Describe the types of creatures that you and your classmates caught with each kind of trap.

What are the names of the creatures you caught? Use the identification key in Chapter 1 to identify the creatures that you collected.

Where did you catch the most flying creatures?





HOW TO MAKE A "POOTER"

A. Make two holes in the lid of a large pill vial. Fit a milk-shake straw and a one-metre length of one-centimetre diameter rubber or plastic tubing into the holes. Use plasticene to plug any gaps between the tubing or the straw and the lid of the pill vial.

B. Tape a piece of cheesecloth over the end of tubing inside the lid.

C. Put the lid on the pill vial. Your "pooter" is complete and ready for use!

Activity 2:

How can a cage be built to house small creatures that fly?

Small creatures captured alive in Activity 1 can be kept in an insect cage. Several plans are included here so that you can choose a cage suitable for the small creatures that you have collected. Before you choose a cage, find out more about your animals. Use books from your library to discover the habits and needs of your animals. Make short notes on the information that interests you.

When you make your cage, remember to supply the basic needs of each animal. Do your insects require a particular plant on which adults can lay eggs and on which the larvae can feed? If so, have you provided it?

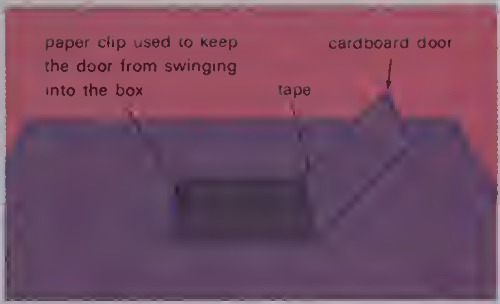
Perhaps your animals do not feed on plants. What do they need? A ladybug home, for example, should have some rose stems and leaves with tiny green bugs called aphids.

Also, use the information on your labels to decide what type of home your small creatures need.

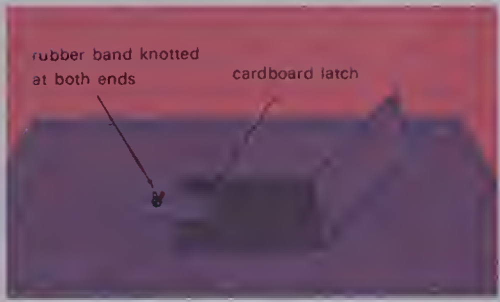
On the cage you make, put labels like the ones on the collecting jars.

CAGE 1. FOR LARGE, FLYING INSECTS

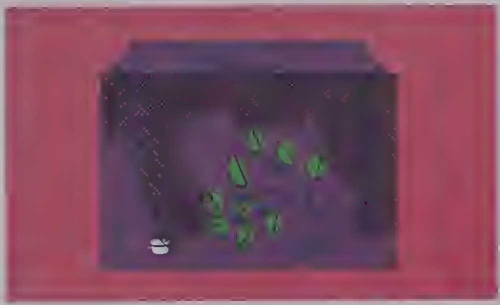
A. Get a large, sturdy cardboard carton. Cut the bottom end out of it. If the carton has large cracks along the top or the sides, cover them from the outside with masking tape and Bristol board.



B. Cut a 10 cm by 10 cm square hole in one side, so that you can reach into the cage comfortably. One type of door can be made by taping the extra piece of cardboard to one side of the hole. The tape acts as a hinge, allowing you to open and close the door.



C. A latch can be made using a small, thick piece of cardboard and a long rubber band.



D. Place twigs, a water bowl, and suitable foods in the cage. Tape or staple fine nylon screening or cheesecloth over the open end of the box. Now the cage is complete.

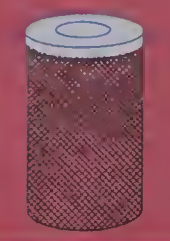
CAGE 2. FOR SMALL INSECTS THAT FEED ON LIVING PLANTS

A. Get a coffee-can lid or the top of a plastic ice cream container. Roll a piece of finely meshed, but fairly stiff, screening into the shape of a wide tube. One end of the tube should fit snugly into the lid. To keep the shape, sew or staple the screening. The lid at the top can be used as a door to the cage.

B. Choose a flower pot that is larger in diameter than the other end of the screening. Plant some grass and other small plants in the flower pot. Use plants that provide suitable food for the animals that you plan to place in the cage.

C. Place the screen over the plants, and insert its edges into the soil in the flower pot. Place your small flying creatures into the cage. Don't forget to water the plants each day. Just moisten the soil on which the plants grow. Try to avoid pouring water over your small creatures.

CAGE 3. FOR SMALL CREATURES THAT LAY THEIR EGGS IN WATER



A. Make cylinder as in Cage 2.

B. Get a plastic container, and fill it with pond water. As it evaporates, replace the pond water with more pond water. Slowly pour it on the inside edge of the mouth of the container. If you let the pond water dribble into the cage when you have completed the cage, you will not drown your small creatures.

C. Insert the screen in the water container. Add a few twigs, and your small creatures.

CAGE 4. FOR SMALL CREATURES WITH SPECIAL NEEDS

A. Get a large empty jar. In the bottom of the jar, place twigs, a shallow water container, a rock, and anything else that your specimens may require.

B. Add your small creatures, and place a piece of cheesecloth or nylon stocking over the mouth of the jar. To keep the creatures from escaping, put a rubber band over the cheesecloth around the neck of the jar.

Digging Deeper

How closely does your cage resemble the animals' natural home?

Choose a small creature in its cage. Study its habits as it moves, feeds, or rests. What do you notice about it?

Where did you get food for your animals?

Activity 3:

How long does it take a fruit fly to complete its life cycle? Does it take more or less time when it is hot or cold?

Fruit flies are bothersome insects, but at least they are easy to catch.

Get two ripe bananas. Place one in a bag for later use. Cut the other one into four sections, and place two of the pieces in a large jar. Cover the jar with a paper funnel. A funnel is shaped like an ice cream cone, but it has a very small opening at the point.

Place your fruit fly trap in an open area outdoors, and leave it for two hours.

Revisit your fruit fly trap. If it was successful, and you have ten to twenty fruit flies, return to your class. If not, wait a bit longer or set up your fruit fly trap somewhere else.

Take the banana from the bag. By now, it is probably so ripe, it is black. Cut the banana into three equal sections. Place the sections in a large jar. Put the fruit flies you have collected in this jar. Cover the jar with a piece of nylon stocking. Let the jar sit in the classroom for a day, and watch the skin of the banana carefully with a hand lens or magnifier.

Why is there a small opening in the funnel?

Fruit Fly Life Cycles in Different Temperatures

Day 1	Jar 1	Jar 2	Jar 3
Temperature 09:00 12:00 16:00	2°C	21°C	38°C
Eggs	Yes	Yes	Yes
Larva			
Pupa			
Adults			
Comments			

When you notice eggs (tiny white specks) on all three pieces of banana, remove the adult flies from the jar. If you wish to let them free outdoors, you may. Place each section of banana in a separate jar, and cover it as before.

Pack one jar in ice cubes, so that the temperature inside the jar is cool. The temperature should be above freezing at about 2°C to 5°C.

Place the second jar on a radiator or in a pan of warm water, so that the temperature in the jar is 32°C to 38°C. The first two jars are the experimental containers, because they represent hot and cold temperatures.

The third is the control jar, because it represents normal conditions. Keep it at room temperature, 20°C to 23°C.

You might have some difficulty keeping the jars at the proper temperatures. However, if you look after them often, you should be able to keep the temperatures hot, medium, and cool.

Look at the three jars each day, and make records of what happens on the banana skin and on the glass of the jar. Normally, a fruit fly goes through its entire life cycle in about two weeks. Draw a picture of each new stage of the life cycle that you see.

Digging Deeper

How many days did it take for the fruit fly eggs to hatch in each jar?

Which jar had the greatest number of fruit flies? The least?

In which jar did you first see adult fruit flies? Which was the last jar to have adult fruit flies?

All the possible reasons the life cycle might be affected are called *factors*. Any one of such factors might make the answer change or vary. What is the only factor which might have caused the flies in any jar to complete the life cycle faster?

How many changes are there in the life cycle of a fruit fly? What are those changes?

Under normal conditions, how much time does a fruit fly spend as a larva? As a pupa?

How long after a fruit fly becomes an adult does it lay eggs?

Why did the larvae leave the banana and crawl onto the glass of the jar?

How would you do an experiment to find out what effect light has on the life cycle of a fruit fly?

Are you conducting a 'fair' activity when you carry out a controlled experiment? Explain.

Each day complete a chart similar to the one shown.

Activity 4:

How do butterflies taste foods?

If you have live butterflies in any of your cages, they can be used for this activity. Otherwise, you must first capture some butterflies outdoors.

Begin with four small containers of the same size, and fill them to the same level with water. Leave only water in the first container. Dissolve one sugar cube in the second container; two cubes in the third; and three in the last one.

Number the containers, and label each container with its contents.

You need to be able to hold each butterfly without damaging it. Cut two strips of stiff cardboard slightly larger than the butterfly. Place one piece on each side of its wings. Use a paper clip to keep the pieces of cardboard firmly together. Be careful not to put the paper clip on the butterfly's wings, instead of on the cardboard.

Use a clean toothpick or strip of paper for each of the four glasses. Try not to get them mixed up as you do the experiment. Dip a toothpick or strip of paper in the water without any sugar, and rub it along the front legs of the butterfly. What happens?

Repeat this procedure with the water and sugar solutions. Record what happens each time on a chart.

If your butterfly does not react, place it in a jar and starve it for a few hours. Then repeat the activity. A butterfly can live without food for at least one day.

How Does a Butterfly React to a Sugar Solution?

Butterfly	Glass 1: Water without sugar	Glass 2: Water plus one sugar cube	Glass 3: Water plus two sugar cubes	Glass 4: Water plus three sugar cubes
Monarch				
White				
Swallowtail				

A monarch butterfly reacts to the solution on the toothpick.

Digging Deeper

To which solutions did the butterflies react?

What happened during each reaction?

What part of the body did the butterflies use to "taste" the solutions? Describe this part of the body. What is it called?

At what times would a butterfly use its sense organs to taste foods?

Is a butterfly's ability to taste foods better than yours? Explain.

How are a butterfly's taste organs the same as yours, and how are they different? How do the ways they look compare? How do the kinds of food they taste compare?

What reaction does a butterfly have to salt solutions? How can you find out?

How can you find out whether all insects fly at the same height?

Activity 5:

At what different heights above the ground do small creatures fly?

One thing all the creatures you have studied in this chapter have in common is the ability to fly. Flight enables these animals to wander farther than wingless insects. Do some types fly closer to the ground than others?

Get a 3 m length of lumber 5 cm by 5 cm. Sharpen one end with a hand saw, so that it has a sharp point. You might get someone to help you.

Mark the pole every fifteen centimetres from the top to the ground level, as in the diagram. At the top of the pole, mark one of the directions on each side (N for north, S for south, E for east, and W for west).

Pick one area that is convenient for you, and set up the experiment before school starts in the morning. You might choose a grassy lawn, a field with tall grass, a shaded area, or a garden.

Use a magnetic compass to help you turn the pole, so that each of the four sides faces north, south, east, or west. Force one end of the pole into the ground. Smear all four sides of the pole with petroleum jelly (Vaseline).

When you revisit the site after school, carefully examine each fifteen-centimetre length of the pole.

Record your findings on a chart like the one shown. Place an ''X'' on your chart to show where each creature was found. Pick the creatures from the pole with

tweezers. (For how to make homemade tweezers, see page 38.)

Put the creatures in the plastic pill vials, labelled with the height at which the creatures were found.

Use paper towels to remove the petroleum jelly and any remaining small creatures from the pole, so that the pole can be used again.

Digging Deeper

At what height above the ground were most animals caught?

What sections of the pole had no trapped animals?

Were these findings the same for all four sides of the pole? Explain.

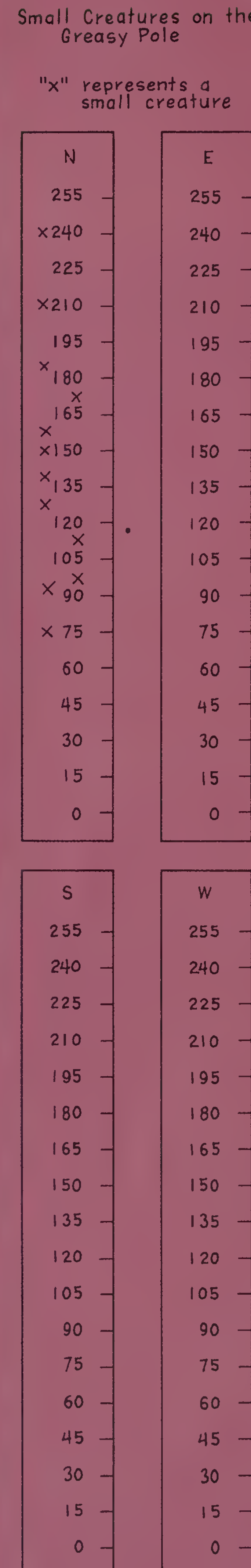
What was the total number of flying animals caught?

Which side of the pole had the greatest number of small creatures — north, south, east, or west?

Which side of the pole had the smallest number?

What effect do you think wind had on the number of flying creatures that you found in each section? What about temperature? Time of day? Closeness to trees or bushes?

How could you test what effect any of these had on the number of flying creatures?



Activity 6:

Can a bee tell other bees where food can be found? (This activity is a reading exercise.)

An observant person noticed that when honeybees find a source of food in flowers, they return to the hive with their pollen baskets filled, and perform a kind of dance in front of the other worker bees. The wagging dance makes these bees excited, and they leave the hive to find the source of the food.

The observer asked himself these questions:

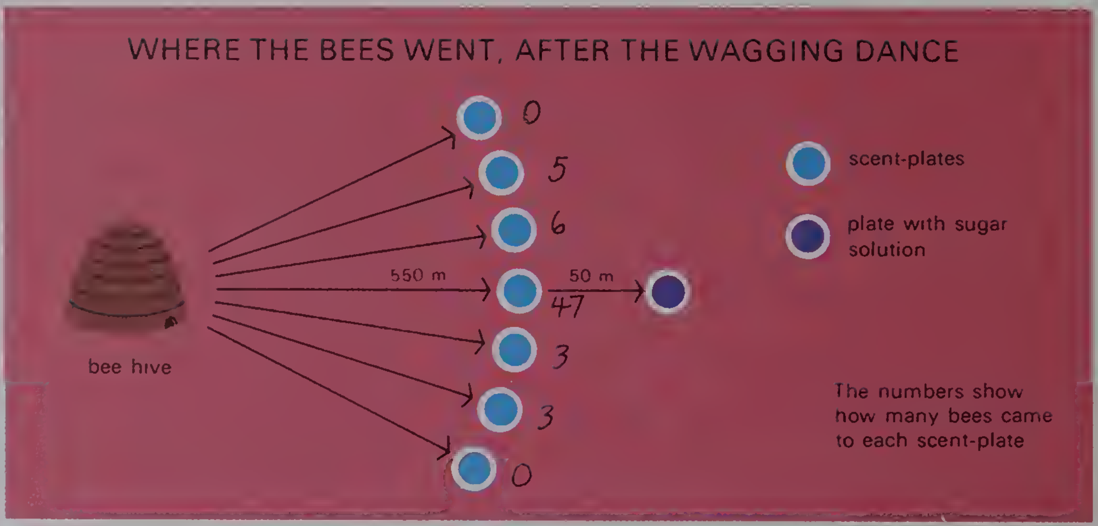
How do the bees know where to find the food?

Is it possible that the way a bee dances tells the other bees where to look?

Does the dance of a bee tell the other bees in the hive the distance and direction of food that it has found?

He then did some experiments to answer his questions. Read to find out how well the experiment was done, and whether the question was answered.

A dish with a sugar solution was set up six hundred metres from the hive. Because the sugar solution was a food source, this dish would attract the bees. Other dishes were set up in a fan shape, as in the diagram. These dishes contained no sugar solution, but were made to smell as though they contained a sugar solution. Each of these seven scent-plates in the fan shape was located 550 m from the hive. One of the empty scent-plates was placed in front of the only dish with a real sugar solution.



To start the experiment, some of the bees were led to the sugar solution. When the bees returned to the hive, they did their wagging dance. For an hour, an observer at each scent-plate counted the number of bees that came to each plate. Study their findings, shown on the diagram.

Digging Deeper

Can a bee's dance point out the direction of a food source to the other bees in the hive?

Does the information in the diagram answer this question? Explain.

List the factors that were kept the same in the experiment.

Which factor was allowed to change in the activity?

Was the experiment 'fair'? Explain.

Branching Out

Plan an experiment to find out whether or not the bee's dance tells other bees the distance (not the direction) to the food source. Use a diagram to help you show how you would set up the experiment.

Ask a classmate to read your experiment and tell you whether he thinks you are being 'fair' or not. Ask him to explain his answer.

Spiders Are Different 5

5. Spiders Are Different

I Am Different

Just plain bugs
  haven't webs like mine
That glitter with dew
  —they're spun *so* fine;
For I am a spider,
  a weaver of webs,
I have no wings,
  but I have eight legs.
You see me
  in your houses
And ballooning
  in the air,
But I hope you *never* squish me
  by sitting on a chair!

Phoebe Little

The poet suggests that spiders are different from "just plain bugs". What differences does she write about? What are some other differences between spiders and insects?

Spiders have been pictured as evil and harmful creatures in some stories and movies. Many people are frightened of even the smallest and most timid spider. Actually, most spiders are shy and would rather find a place to hide or play dead than attack a person.

Spiders have poison glands which they use to stun and paralyze their victims, so that they can feed on the juices of their bodies. However, the jaws of most spiders are not strong enough to break your skin. *Still, you should take care when handling spiders.*

In North America, the only three types of spiders which pose any serious threat to people are the widow spider, the tarantula, and the recluse spider.

Spiders are very helpful to us because they feed on insects, which infest our gardens and fields and feed on crops and livestock. Any animal that causes us no harm need not be feared nor destroyed.

Collect a spider and an ant or grasshopper, and compare them. What do these small creatures have in common? Spiders, as well as insects, are classified in a group of animals known as *arthropods*. This name comes from the Greek words *arthro* (which means joint) and *podos* (which means foot). Does this give you a hint about what arthropods have in common?

Activity 1:

How can spiders be collected?

There are many types of spiders. Each type has its own hunting ground. For some types, soil litter is the hunting ground; for others, the tree tops are.

The recluse spider.

The widow spider.

Spider with egg case.

On your spider hunt take some small containers with lids, as well as a piece of cardboard that is larger than the mouth of the jar. Use a hammer and nail to make some small holes in each lid to give your spiders fresh air. To the side of each jar, fasten a piece of masking tape or glue a strip of paper to record the place you found each spider. Don't forget a pencil.

Start your hunt outside on a clear dewy morning, since the glistening dew on the webs can guide you to the spiders. If no spider seems to be near the web, jiggle it lightly with a twig, and wait to see if the spider comes out of its hiding place.

Not all spiders build webs, so search not only webs, but also places without webs. You can look for spiders in tall grass, garden plants, flowers, shrubs, low-hanging tree branches, bushes around a building, corners near windows, wood piles, and cracks in tree bark.

Complete your hunt indoors. Search near windows, in corners, along walls, and in the rafters. You may need a flashlight to see in dark places, such as a basement.

Go ahead and hunt for spiders in places not mentioned here.

Once you have learned some of the habits of spiders, collecting them becomes easy, since they are to be found almost any place you care to look.

When you find a spider, trap it in the container. Then slowly slide the piece of cardboard over the mouth of the container to prevent its escape. Try not to damage the spider's legs. Since it is difficult for spiders to climb the glass sides, you have plenty of time to screw the lid on. Record the date and the place of your spider's capture.

Why should two or more spiders not be placed in the same jar?

Collect as many different types as you can. After you have collected ten or twelve spiders, return to your school. Put your spiders in a safe place out of direct sunlight.

How is the daddy longlegs different from a true spider?

Digging Deeper

How many places did you examine for spiders?

How successful were you in these areas?

Think of the exact places you found the spiders, and describe the conditions you think your spiders prefer for their homes.

How many spiders did you catch in their webs?

How many spiders did you find hanging upside down in webs? Why would spiders hang in this position?

Of the spiders that you didn't catch in their webs, how many do you think are web spinners? How can you be sure?

Branching Out

How can you keep your spiders alive? Keep each one of your spiders in the same jars, if the containers are large enough. The containers should be fairly large for web-making spiders. If you move any spiders into larger containers, be sure to punch small holes in the lids. Store the jars in a cool, shaded part of your classroom. Add a few drops of water to the bottoms of the jars. (Don't drown the spiders!) Feed them live insects, such as flies.

Why not keep a house fly colony, such as the one described in Chapter 2, page 24? Then, a supply of flies to feed your spiders is available at any time.

Activity 2:

How can the spiders in your collection be identified?

One of the first questions that is asked about an interesting plant or animal is: "What is it?" It should be easy to answer that question about your new collection of small creatures. Of course, they are spiders! But what kind of spider is each one?

Take a closer look. Are all the spiders of the same type? Place together all the jars that you think contain the same type of spider. Take another, closer look. What do your spiders have in common? Explain why you placed the spiders in each group.

Read the labels on the jars. What other things have you noticed so far about your spider? This information should be a great help to you in correctly identifying your spider.

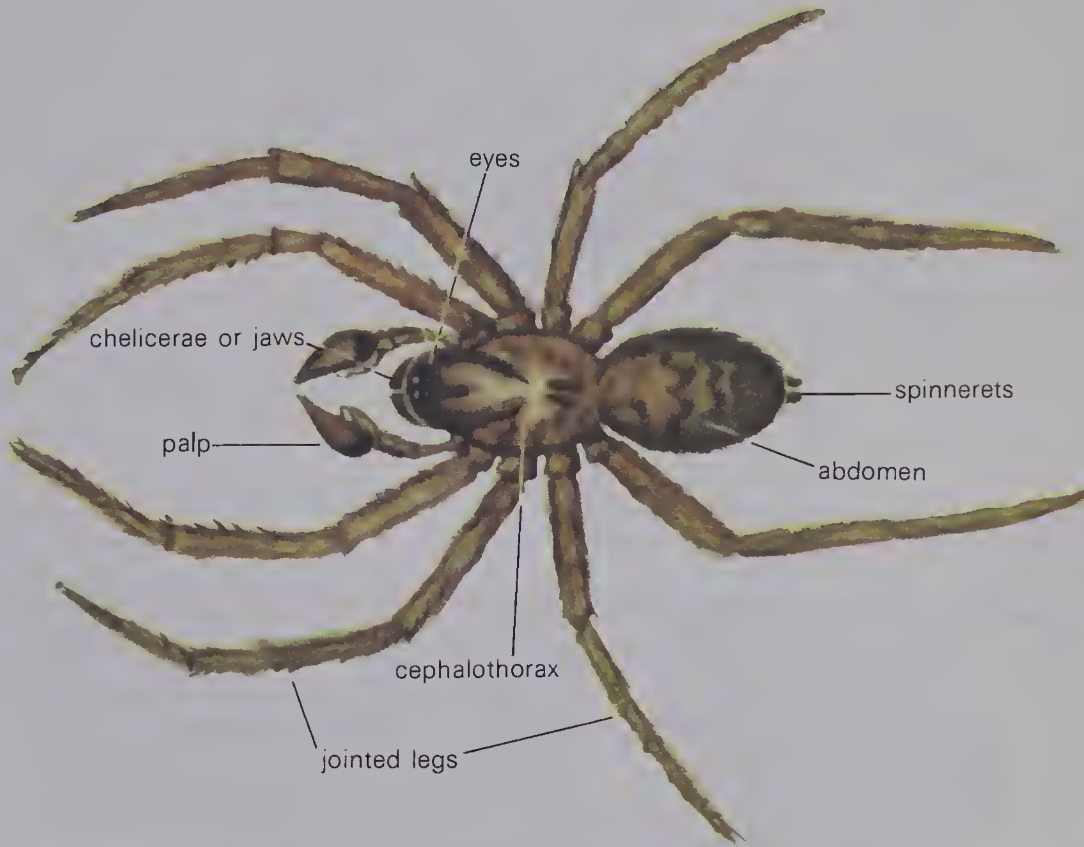
The key on the next few pages is used in the same way as the key in Chapter 1. Look at the first description inside the heavy borders of each spider group box. When you find a description that fits, read the other descriptions in the box for that spider group. Decide which type of spider you have.

(Note: The spiders are not necessarily shown in their actual sizes.)

The photographs show spider homes you could make. See-through glass or plastic makes spider-watching easier. Don't forget air holes.

IDENTIFICATION KEY FOR SPIDERS

If your small creature has eight legs and two body parts, it is a SPIDER.
One body structure that all spiders have is the set of spinnerets at the rear and underside of the abdomen. The spinnerets are used to spin silky threads.



Look at the diagram of the parts of a spider's body. Where are its chelicerae or jaws? With a strong magnifier look for its jaws and fangs.

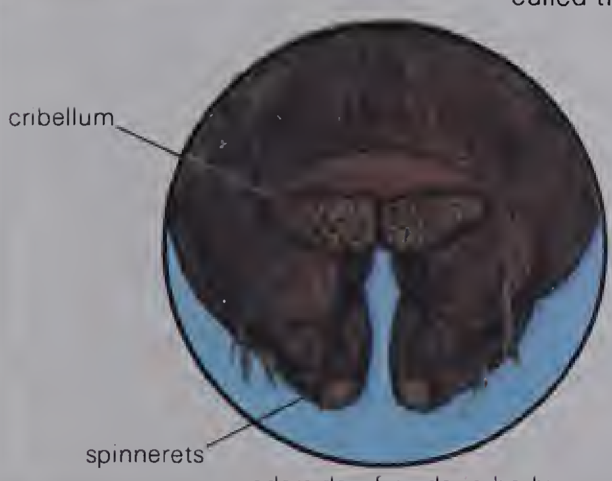
TRUE SPIDERS

If it has chelicerae or jaws with fangs that curve inwards, it is a TRUE SPIDER.

Examine it carefully.

Cribellate Spiders

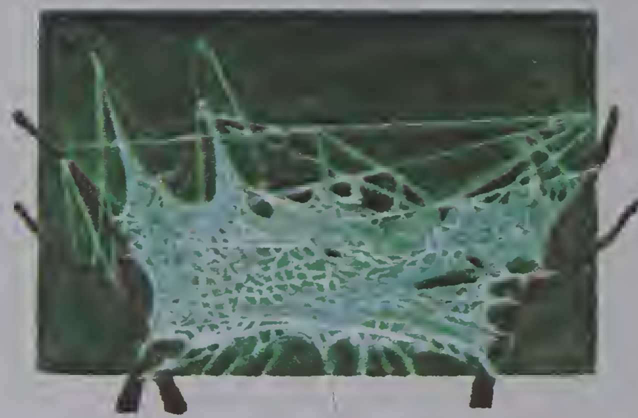
Look at the underside of your spider. If in front of the spinnerets there is a flattened sievelike plate called the cribellum, it is a CRIBELLATE SPIDER.



underside of spider's body

If it has no cribellum, and if it spins silk strands into a fancy web for capturing its prey, it is an AERIAL WEB WEAVER.

If it weaves a sheet with a few sticky threads, if it has a patterned abdomen which is longer than wide, and if it has bristles on its legs, it is a SHEETWEB WEAVER.



If it weaves an orb web, it is an ORB WEAVER.

One common orb weaver is the GARDEN SPIDER.

If it weaves a tangled network of silk, it is a TANGLED WEB WEAVER or COBWEB WEAVER.

If it has patches and streaks on the sides of the abdomen, it is one of the ACHAEARANEA SPIDERS, found world-wide.

One of these is the common American house spider.

If it is twelve to sixteen millimetres long, and if it has distinctive markings, it is probably a female WIDOW SPIDER.

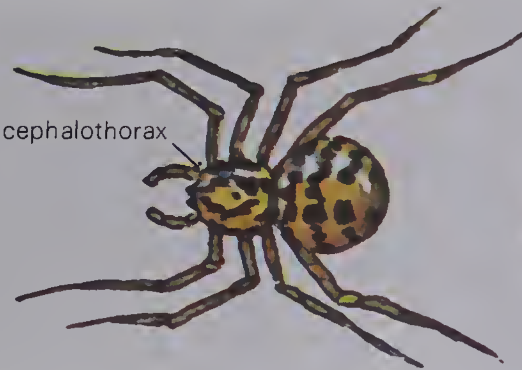
It is poisonous to man and is found all over the world. Males are smaller and do not bite.

The BLACK WIDOW and the NORTHERN WIDOW are black with red markings. The Northern Widow inhabits southern Canada and parts of the United States.

Primitive Hunters and Weavers

Spiders that trap their food, but usually weave only a few simple sticky lines for capturing their prey are called the PRIMITIVE HUNTERS AND WEAVERS.

If the cephalothorax looks very rounded from above, and if the spider squirts a sticky gum from its mouth to capture its prey, it is a SPITTING SPIDER.



If it is dull brown in color, and it weaves an irregular mesh of sticky silk, it is a BROWN SPIDER. One type of brown spider is the RECLUSE SPIDER, which is poisonous to man.

Hunting Spiders

If they have stout legs of moderate length and overpower their prey by force without relying on silk, they are HUNTING SPIDERS.

If it is most likely to be found in prairie grass and if it has eight eyes and a long cephalothorax which is high and narrowed in front, it is a WOLF SPIDER. (Some spiders have six eyes or fewer.) The mother wolf spider attaches the egg sac to her spinnerets. Some wolf spiders dig burrows.

If it is found near the moist edges of ponds and rivers, and if it resembles the wolf spider, but the mother carries her egg sac in her jaws, it is a NURSERY WEB WEAVER or a FISHER SPIDER. These spiders can skate on the water and remain underwater for short periods. They have been known to prey on small fish as well as insects.

If the mother attaches the egg sac to some plants and carefully guards it, and if it has legs with long, strong, black bristles, it is a LYNX SPIDER.

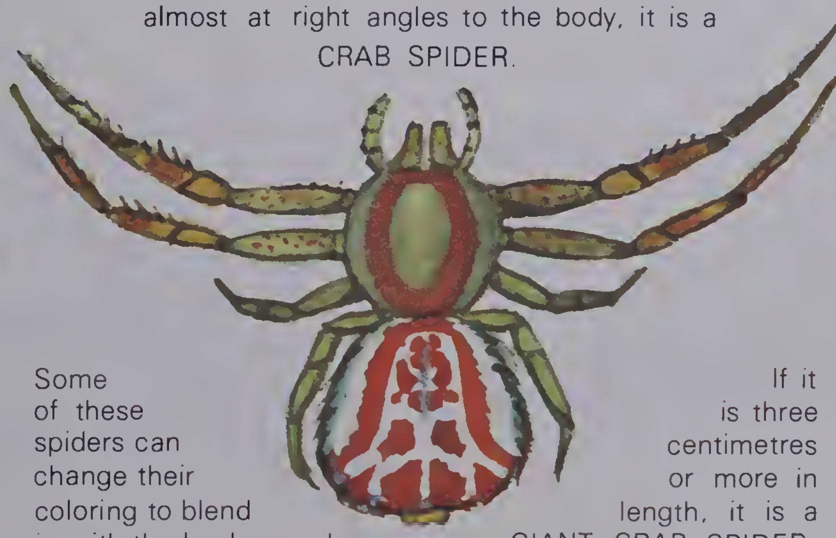
If it has long, thin legs, if its whole body is covered with featherlike hairs, and if it sits shyly in its funnel web, it is a FUNNEL-WEB WEAVER. This web, which is open at both ends, is not used only as a trap — it's a hiding place. Two funnelweb weavers are GRASS SPIDERS and CELLAR SPIDERS.

Running Spiders

If it has a long body with its front legs pointing forwards, and if it chases its prey, it is a RUNNING SPIDER.

If it has a long, flattened abdomen, black or brown coloring, few markings or none, and if most of its body is covered with velvety hairs, it is a GNAPHOSID SPIDER. Some of these spiders have oval eyes that reflect light at night.

If it has a short, flattened body, if its front legs are long and its back legs are short, and if these legs stick out almost at right angles to the body, it is a CRAB SPIDER.



Some of these spiders can change their coloring to blend in with the background.

If it is three centimetres or more in length, it is a GIANT CRAB SPIDER.

If it is no longer than one and a half centimetres, if it has a short stout body, short legs, and a rectangular cephalothorax, if it is covered by a blanket of brightly colored hairs, and if it catches its prey by jumping on it, it is a JUMPING SPIDER.

TARANTULAS

If the fangs are curved downwards, and the spider's jaws move up and down, it is a type of TARANTULA. Look at how big its body parts are, and find out where it lives.

Hairy Tarantulas

If it is very large, with a body from five to nine centimetres long, if it is very hairy, and if it has a pad of shiny hairs on the underside of each foot, it is a HAIRY TARANTULA.

Their homes are found in warm climates. Most hairy tarantulas are not poisonous to man. They are also known as BIRD SPIDERS, because some have been known to prey on small birds.

Funnelweb Tarantulas

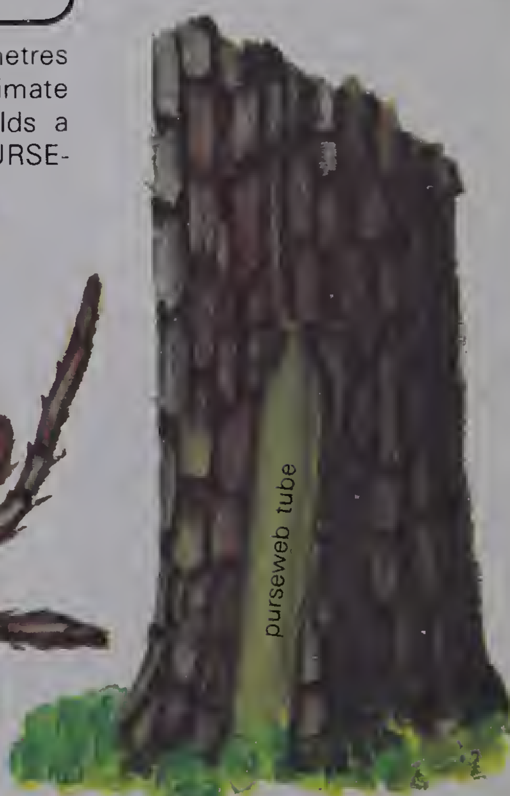
If it is no larger than five centimetres, its spinnerets are about half the length of the abdomen, and it lives in a funnel-shaped web, it is a FUNNELWEB TARANTULA. An Australian funnelweb spider is known to be poisonous.

Trapdoor Spiders

If it is from one to three centimetres long, with jaws that have a spiny ridge along the front, it is a TRAPDOOR SPIDER. The spiny ridge or rake is used to dig its burrow. At the opening of its home, there is a hinged trapdoor, made by the spider, that can be opened and closed.

Purseweb Tarantulas

If it is less than three centimetres long, lives in a temperate climate of North America, and builds a tube-shaped web, it is a PURSE-WEB SPIDER.



You might try to find other books to help you identify spiders.

Make a tally of the types of spiders caught by your classmates participating in this activity. Find out the numbers of each type caught in different places.

Digging Deeper

How many of your spiders do you think you correctly identified?

To how many did you give "Spider X" names?

How many spiders of each type were in your collection?

What types of spiders are most numerous in your collection?

Are web-making spiders more common in your collection than spiders that do not make webs?

Did you notice that some spiders had swollen *palps?* The palps of some other spiders are not enlarged. Use books to discover why some spiders have swollen palps.

Male spider with swollen palps.

Female spider with slender palps.

Activity 3:

Is it true that spiders prefer live insects?

Different animals behave in special ways. Most types of spiders have their own ways of behaving that are different from the habits of other types of spiders. The ways that an animal behaves help it to survive in its surroundings. An animal that changes its habits to suit its surroundings has a better chance of survival.

In your opinion, what habits affect a spider's ability to survive? Ways of protecting itself and its young? Style of movement? The nature of its mating ritual?

In this activity, you discover something about the spider's feeding habits.

Choose one of your spiders for this experiment. Keep it in a jar out of direct sunlight during the experiment. Also, try to keep the same moisture and temperature conditions in the jar all through the experiment.

Catch ten house flies, perhaps in your house fly colony. Keep five of the flies alive by placing them in a jar with some sugar and a moist piece of paper towel. Kill the other five flies by placing them in a jar in a freezer for an hour. Remove one wing from each of the dead flies to distinguish them from the live ones.

Take a live fly and a dead one, and release them in the spider jar. If you have a web-making spider, make sure that both flies become entangled in the web. Watch what happens.

Repeat the activity on each of the next four days using a live house fly and a dead house fly every time. Feed the spider at approximately the same time each day. The time should be convenient for watching the feeding habits of the spider.

Complete a chart showing what happened each day.

"Will you walk into my parlour?" said the Spider to the Fly.

The spider wraps its prey in silk.

Dinner time.

Digging Deeper

From the data you have gathered, what statement can you make concerning your spider's preference for live or dead house flies?

Would your statement be true for live and dead grasshoppers? How could you find out?

Describe what the spider did before it fed on a house fly. Did the spider actually eat the body of its prey? Explain your answer.

How long can you keep your spider alive? Most spiders in the temperate zones of the world live only one year.

Spider's Choice of Food

Day	Feeding Time	Food	Spider's Choice	Comments
1		Live house fly Dead house fly		
2		Live house fly Dead house fly		
3		Live house fly Dead house fly		
4		Live house fly Dead house fly		
5		Live house fly Dead house fly		

Activity 4:

How strong is the silk produced by a spider?

Get a wire coat hanger, and bend it to form a rectangle about 12 cm by 24 cm. This is to be your silk frame that you can use to "milk" spiders. Wind strong adhesive or bookbinding tape around the two ends of the wire that join at a corner, or bend the ends together with pliers.

From one of the cages, take a spider that spins silk. Start the spider spinning its dragline by letting it drop from your hand. Place the wire frame under the strand of silk so that the silk hangs across the frame. As the spider continues to spin its dragline, turn the wire frame so that the silk is wound onto the frame. Make twenty-five full turns of the frame in such a way that the silk threads are spread out across the frame.

Support the silk frame on two books at the ends of the frame.

Cut a piece of Bristol board about 9 cm by 18 cm, and let it rest on the silk inside the wire frame.

Choose one kind of mass that is available to you. You could use pieces of plasticene, nuts, coins, or other small objects. Make sure each of your items has the same mass. Place the masses, one at a time, on the piece of Bristol board, and watch what happens to the silk. How can you be certain that you are using equal masses?

Repeat this activity, and test the strength of the silk of other spiders.

▲ *The silk threads should be spread around the wire frame evenly.*

Record your data on a chart like the one below. ▼

How Strong is Spider Silk?

	Spider 1	Spider 2	Spider 3	Spider 4
Number of masses under which the threads broke				

Digging Deeper

What happened to the silk threads on the frame as you added the masses?

How many masses did you place on the Bristol board?

How many masses did it take to break the threads?

On a balance, measure the masses that you used to find out their masses in grams. What is the mass of the Bristol board? Under how much mass did the threads break?

Which of your spiders produces the strongest silk? The weakest silk?

How do you think your results would be affected by the way in which you wound the silk onto the wire frame?

Why is it important for spiders to spin strong silk?

Branching Out

How stretchy is spider silk? Stick two nails upright in two pieces of plasticene, and place them fifteen centimetres apart on a table top. Wind one strand of spider silk around the two nails, so that there is no sag in the middle. The thread should not hang loosely.

Measure the exact distance between the two nails. Slowly, move one of the nails away from the other. What is happening to the silk?

How far can you move the nail before the thread breaks?

How stretchy is the spider silk?

Is the silk produced by your other spiders more stretchy or less stretchy? How could you find out?

In what ways do you think this stretchiness of the silk is helpful to the spider?

Touching an orb web.

Activity 5:

How is an orb web constructed?

Here is a series of photographs showing how an orb or wheel web was built. Study the description and the photographs in order to learn how this ''master engineer'' was able to complete the web.

Sketch the web of one of the orb weavers you have captured.

Digging Deeper

Why could you say that the spider that built this web plays a ''waiting game''?

Why do you think that orb webs are constructed vertically (straight up and down)?

How long does it take an orb weaver to finish its complicated web?

How long does an orb web last?

How might the orb web get damaged?

What will the orb weaver do when the web is damaged?

Branching Out

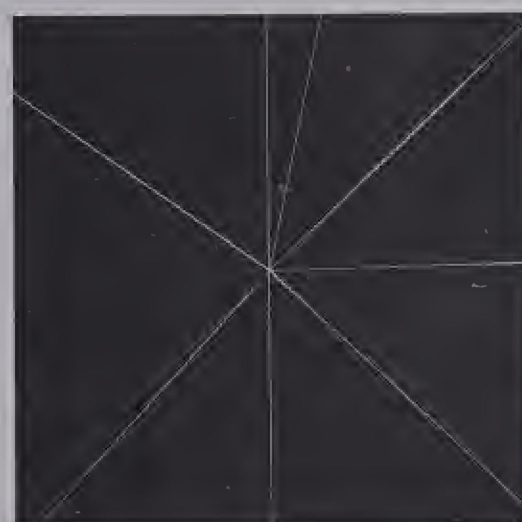
To make orb art, follow these directions:

Find an orb web that has not been damaged. It should be free of the remains of the spider's prey. The web should be dry and not covered with dew.

Stand about one and one-half metres away, and spray the web lightly from a spray can of paint. You might use white, gold, or any other color that you wish. When the whole web is coated well, but lightly, bring a piece of Bristol board, construction paper, or cloth against the

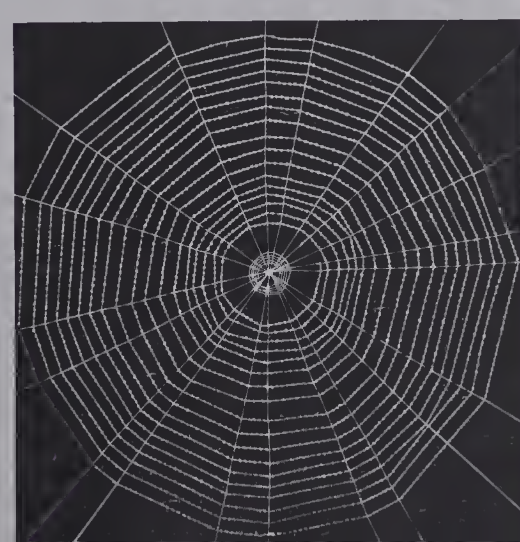
◀ *The spider begins the web by spinning a line across the space where the web will hang. The spider completes the outer framework for the web. Then a vertical thread is dropped through the middle of the frame.*

▶ *A closer view of the vertical thread, from which radial spokes are spun.*



◀ *The spider has begun to spin the radial spokes.*

▶ *The center is strengthened by more silk threads, and radial spokes are connected by a spiral of dry threads.*



◀ *Starting at the outside edge, the spider spins sticky threads toward the center. Before reaching the center of the web, the spider stops. The web is complete.*

The first three photographs illustrate steps in preserving a spider web--one form of orb art.

web. For the paper or cloth, choose a color on which the painted strands of silk will stand out clearly.

As the paper, cardboard, or cloth touches the web, have a partner gently blow any loose strands against it. Ask your partner to cut the extra strands that connect the web to the plants and rocks around it.

When the web is dry on the material that you have chosen, it is ready for display. Be careful not to place heavy objects on it or slide anything against it. Displayed in a picture frame or acetate sheet, it could last for years.

The photograph at the bottom of the page shows another form of orb art. You might wish to collect the simple materials, and make a similar model.

Activity 6:

Which of your spiders will balloon?

Many curious habits of spiders have been recorded. One oddity is the *ballooning* of some young spiders soon after they have hatched. The *spiderlings* climb to high places nearby such as buildings, trees, or bushes. The young spiders then face the wind and spin out a dragline to be caught in the breeze. With legs spread straight out, the wind sweeps the spider on its silken thread into the air. The nimble spiders are able to balloon long distances from their birthplaces. Spiderlings have been known to land on the sails of ships more than three hundred kilometres from the nearest land. They have even been

The photograph at the right shows the spider's silk coming out of the spider's abdomen. The silk comes out of tiny tubes called spinnerets.

Which Spiders Will Balloon?

Test	Spider 1	Spider 2	Spider 3	Spider 4
1	yes			
2	no			
3	yes			

found three kilometres above the earth's surface. Some scientists believe that ballooning has been largely responsible for spreading different types of spiders all over the world. Do you agree?

Ballooning is not restricted only to spiderlings. Many more fully grown spiders have been known to balloon. Try to get the spiders in your collection to balloon for you by doing the following:

Take one of the spiders, and place it on a table top. Let it climb onto a pencil. When the spider reaches the end, hold the pencil so that the spider is facing you. Blow steadily in its face, and watch for the spider to get in position to jump into the airstream. The spider will raise its abdomen and pose in a funny diving position just before it is ready to leap.

Why don't you test your other spiders to see which ones will balloon? Repeat the procedure with a different spider.

You will find it easier if you have an electric fan to provide the steady ''wind''. Besides, using the fan is more 'fair' when you compare your different spiders for ballooning.

Give each spider three chances. Record your observations on a chart like the one shown.

Digging Deeper

How many of your spiders ballooned during the tests?

Which spider ballooned the best? The worst?

What types of spiders were better ballooners?

What types did the poorest job of ballooning?

Compare the sizes of the better to the poorer ballooners. Do you think that size has an effect on whether a spider will balloon?

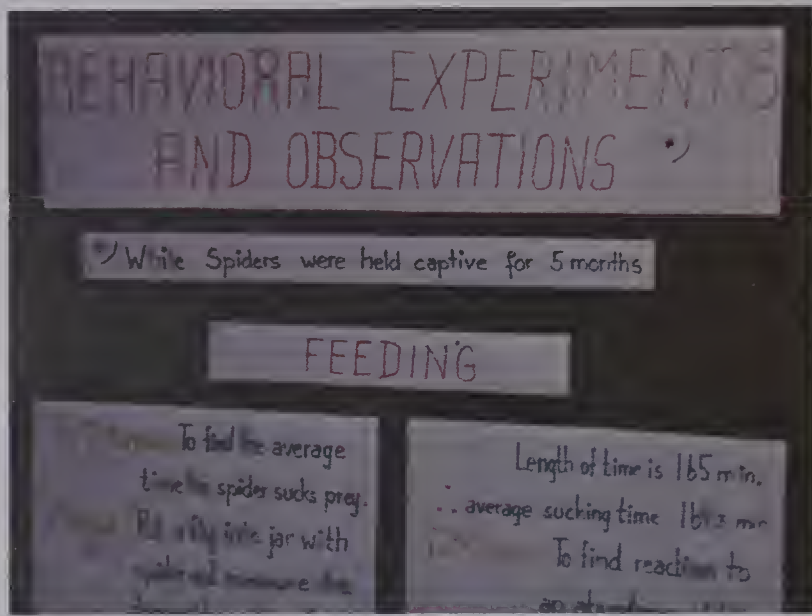
Were any of the spiders young spiderlings? If not, try to find a young spider, and try the activity with it.

What is *gossamer?* How could you find out?

Branching Out

There have been many uses for spider silk. Primitive people have a long history of using spider silk. The natives of New Guinea used spider silk to make dip nets with which they caught fish for their food. Other natives have used spider silk to make small bags in which they carried some of their arrowheads and tobacco. Some natives fashioned headdresses out of spider silk to wear in wet weather and to keep their heads dry from the rain.

Your data could be organized on a chart like this one.



Why are spiders fascinating to study?

Woven gloves and stockings have been made from it. However, many problems occur in getting and using the silk, so that silkworm silk has been more popular in the textile industry. Of course, even this material has been used less since the development of man-made fibers like nylon and rayon.

Spider silk is still used for cross hairs in optical instruments.

Equally as fascinating as the stories about how man has used spider silk are the legends and superstitions about spiders. Some people worshipped types of spiders, since they thought that the spiders had special kinds of powers.

You might enjoy reading about spiders. The bibliography at the end of *Small Creatures* suggests several books for you.

The girl shown in the photograph is Sylvia, who has a great interest in spiders. For her school board's science fair, Sylvia did her project on spiders. Sylvia won first prize out of over one hundred and fifty exhibits!

The reason for Sylvia's successful work is that she had many interesting questions about spiders. She then devised ways of finding answers for her questions. Sylvia's activities ,were done in a 'fair' way.

Study some of Sylvia's investigations from the photographs. Perhaps these experiments will trigger questions in your own mind about your spiders. If so, try to devise ways of finding answers to your questions, but always try to be 'fair' in your activities.

If you are really interested in spiders you might like to join a club for children and adults who enjoy studying spiders. The National Arachnid Society prints a newsletter and tries to help members with their hobby. For more information write to:

Mrs. Ann Moreton,
The National Arachnid Society,
Route 2,
Powhatan, Virginia,
U.S.A. 23139

Creatures on Display 6

6. Creatures on Display

This chapter helps you to make a lasting display of your creatures, so that you can continue to learn about them after you have done activities with them. The displays that you and your classmates make by following the directions in the activities might be the beginning of an interesting hobby.

How do you feel about killing small creatures? Perhaps you think nothing of killing insect pests such as mosquitoes. Maybe you feel that, without a good reason for killing them, helpful creatures such as the praying mantis or spider should be left alone.

In this chapter, killing is necessary for displaying the creature and for further study. There is nothing wrong with killing a small creature *humanely* for a worthwhile reason. Even so, you may feel a little queasy about killing a small creature. What do you think is a worthwhile reason?

On the other hand, if you believe in killing ''anything that moves'', you should re-examine your attitude, since it is this attitude that has caused many animals to die off. Some types of animals have even become *extinct* — that means there aren't any more of them left.

After you have completed your displays, examine your specimens, read about them, and observe other creatures of the same type.

You may have some small creatures in good condition that are already dead. In that case, you don't need to use a killing jar — you already have a head start in doing the following activities.

A beetle collection.

Activity 1:

How can a killing jar be made?

Get a large jar with a lid. The jar should be large enough to hold a butterfly or moth without crushing the wings. Fill a paper or styrofoam drinking cup halfway with plaster of Paris. Add water and stir with a popsicle stick, until the mixture is like thick soup. Carefully pour the plaster of Paris mixture into the large jar, so that it does not dribble down the sides of the glass. Let the plaster of Paris set for an hour with the jar left open.

Obtain some household cleaner or insecticide from a drug store and place a few drops on the plaster of Paris. Let it all soak into the plaster of Paris. Do not leave a small puddle sitting on top of the plaster.

Household cleaners and insecticides are usually poisonous, so be careful, and wash your hands immediately after handling any of them. Replace the cap on the jar when you have finished, and label the jar with the word ''POISON''. Now you have a basic tool to start your creature collection.

The first two photographs show steps in making a killing jar. After you have made the killing jar, select the insect you want to display.

HOW TO USE THE KILLING JAR

Carefully put a small creature in your killing jar, and replace the cap firmly. If your killing jar is made properly, the creature should die quickly and humanely. If you wait a full twenty minutes, you can be sure the creature is dead.

Now you must decide how you want to display your specimen. It is important to work as quickly as possible, moving the wings, legs, and antennae to a desired position. If you wait too long after killing the creatures, the body parts become stiff and break when you try to move them. If a creature does become stiff, place some damp cotton in a large jar, and leave your specimen in the jar for two hours to relax the body parts.

After using the killing jar several times, the fumes may become weak. If so, add more household cleaner or insecticide, as needed.

If you are preserving butterflies, moths, or other creatures with delicate wings, follow the directions in Activity 2 to learn how to spread the animals before displaying them. For any other small creature, go on to Activity 3 to pin and label the creatures.

Digging Deeper

What care should you take with your killing jar? Why?

It might be useful to have several killing jars as you collect different kinds of creatures. What size jar would you use to make a killing jar more suitable for smaller creatures?

Activity 2:

How can a spreading board be made?

A spreading board is used to spread small creatures with delicate wings. The spreading board holds the wings in the proper position to mount in your display later.

Find a corrugated cardboard box. Cut it into the following rectangular pieces:

one piece 30 cm by 30 cm;
three pieces 30 cm by 15 cm;
three pieces 30 cm by 12.5 cm;
two pieces 30 cm by 2.5 cm.

Arrange the pieces as shown in the diagram.

HOW TO USE THE SPREADING BOARD

Place the dead small creature on the spreading board underside down, so that its body fits into the space between the cardboard sections. Move the cardboard section attached with pins, until its body just fits into the space between the cardboard sections. The body of the creature should be held firmly, but not crushed. Cut two pieces of paper one centimetre wide and longer than the length of the wings. Pin a strip of paper on each side of the body to hold the wings in position. Be careful not to push the pins through the wings. Move the wings, legs, and antennae into a natural position.

Leave the creature on the spreading board overnight before mounting it in a display.

Digging Deeper

What kind of wings did the small creatures in this activity have? Describe the wings of each creature.

What is the difference between the dead creature before you put it on the spreading board and after you remove it from the spreading board?

How could you avoid rubbing off the scales from the wings of a butterfly you are spreading?

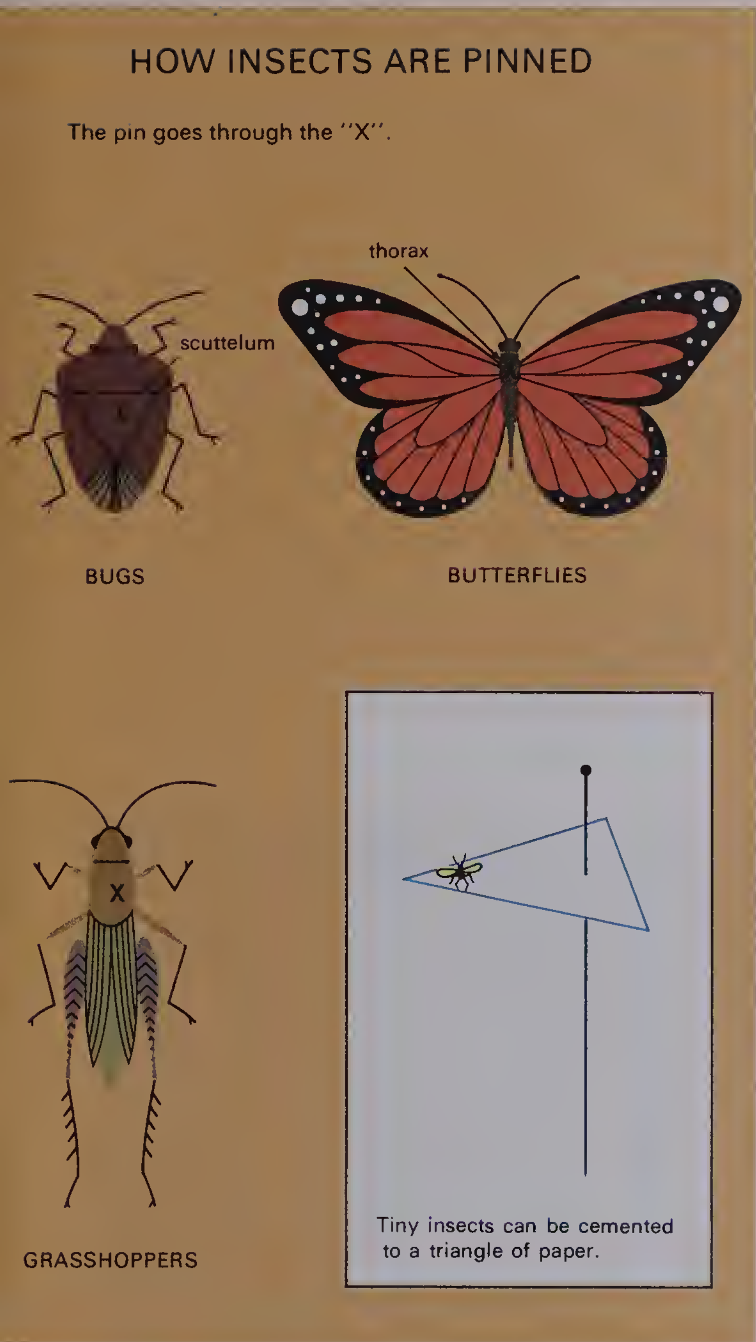
Were any of your specimens damaged as you tried this activity? How could you avoid this the next time you spread an insect?

Activity 3:

How can you pin and label your specimens for display?

PINNING:

When pinning small creatures, the proper type of pin to use is called an insect pin. Number 2 or 3 insect pin is



the best for your use. These pins can usually be bought at your local hobby shop. If it is not possible to find insect pins, use ordinary straight pins. Some small creatures should be pinned in different ways. Study the diagrams to see where to push the pin through the insect's body.

LABELLING:

Each specimen should have three labels. The labels should be made from small rectangles of Bristol board. Since the rectangles are small, you must print neatly.

Your labels should contain the following information:

(1st label) the place where the specimen was found, the date it was found, your name;
(2nd label) information about the place where the creature was found;
(3rd label) the name of your creature.

Study the diagram to find out how to arrange the labels on the pin.

When your insect is pinned and labelled, push the tip of the pin into a cork or a piece of styrofoam. This is a temporary place to keep your specimens. Pin and label the rest of your specimens in the same way. The Branching Out activities suggest ways to make a more permanent display.

Digging Deeper

How did you identify your specimens? How can your labels help you, if you trade specimens with your friends?

Branching Out

Now you can make a storage or display case in which to keep the specimens you have pinned and labelled. Several ways to display your specimens are mentioned here. Choose the one most suitable for you. The two greatest dangers to your specimens are other insects and mold. Spray your specimens with an insecticide or keep a mothball in your display. Also, make sure that the container is dry and air-tight.

DISPLAY IN A BABY FOOD JAR

Simply glue a cork with the labelled specimen to the lid of a clean, dry jar. Let the glue dry, and then tightly screw the lid on the jar. Inside the upside down jar, your specimen can be seen from all sides and its body parts are safe from exploring fingers.

DISPLAY IN CIGAR BOX

Find a strong shallow box. Glue a cork with the labelled specimen to the bottom of the box. You can probably display several specimens in the same box. You could arrange several creatures from one habitat in the same box to show the variety of life in that area. Can you think of other ways to organize the box?

Cover the box with a clear plastic wrapping. Tape the edges down along each side to keep it air-tight and dry.

OTHER KINDS OF DISPLAY CASES

Can you think of ways to use old picture frames, chest drawers, or cookie tins for display cases? What other objects could you use for making a display of small creatures?

Decide how to exhibit your displays of small creatures. Where are you going to show your small creatures? Who is to visit your display? When? What interesting facts about your small creatures can you tell the people who see your display?

Index of Activities

Glossary

Antenna: The feeler of a small creature. Two or more feelers are called antennae (pronounced *an-ten-nee*) or antennas.

Arthropods: Animals without backbones but with jointed legs.

Average: Add up all the numbers to get the total sum. Count the numbers that you added up. Then divide the sum by the number of numbers. The answer is called the average.

Bait: Food that attracts an animal that you want to catch. Earthworms are sometimes used as bait to catch fish.

Ballooning: A habit of spiderlings and some older spiders. A ballooning spider sails in the wind on its silk thread.

Bootleg worm-picker: Someone who picks and sells earthworms without having a license. In some places, this is illegal (against the law).

Classify: To put small creatures into groups according to what they have in common.

Classification system: A way in which creatures are grouped for different reasons.

Controlled experiment: An experiment in which everything is kept the same except the one factor which is being changed to compare its effect on the results. An example of a controlled experiment is *Activity 6: How do different foods affect the number of eggs a house fly lays?* (Chapter 2). In this activity, the only difference between two cages of house flies is the type of food provided.

Data: Information gathered from doing an activity.

Entomologist: A scientist who studies insects.

Extinct: No animals of that type are alive any more.

Exterminator: A man whose job it is to kill harmful insects and pests in people's houses and buildings.

Factor: In an experiment, something that might affect the results.

Fair: Keeping the factors the same in order to compare.

Field guides: Books that help you to identify the different types of small creatures or other things in nature.

Gossamer: Very thin silk in a spider's web.

Humanely: In a kind, understanding way, without cruelty.

Identification: Finding out and knowing the name of a specimen.

Identification key: A description used for identifying the different types of small creatures or other things in nature.

Insect: An animal without a backbone, but with three main body parts, a pair of antennae, and six jointed legs.

Invertebrates: Animals that have no backbone.

Label: To attach a piece of paper or tape to a container, so that information about what is inside the container can be written on it.

Larva: The wormlike stage between egg and pupa. Two or more of them are called larvae (pronounced *lar-vee* or *lar-vi)* or larvas. Maggots, grubs and caterpillars are examples of larvae.

Life cycle: All the stages through which an animal passes as it grows from egg to adulthood.

Maggots: Fly larvae.

Migration: The movement of animals from one place to another. Maggot migration and the migration of some butterflies over thousands of kilometres are examples of migration.

Molt: To shed one's skin.

Over-populated: Crowded with too many animals of one type. When there are too many animals of one type, many usually die, because there is not enough food for all of them.

Palps: The leglike spider parts which are located between the first legs and the spider's jaws. They are used to crush food. The reproductive organs of male spiders are carried in the palps.

"Pooter": A trap for catching small insects by sucking them into a large pill vial.

Pupa: The stage between larva and adult, in which the larva is changed to an adult. In this stage, many types of insects are covered by pupa cases. Two or more insects in this stage are called pupae (pronounced *pew-pee)* or pupas.

Pupate: To change from the larva stage to the pupa stage.

Sample: One out of many, or a tiny part of a large quantity.

Segments: Rows of body parts in one small creature.

Sex: Either male or female.

Soil litter: Soil made up of dead plant material found at the surface of the ground.

Specimen: An animal that was collected.

Spinnerets: The tiny tubes on a spider's abdomen out of which silk comes. Spinnerets distinguish spiders from other members of the spider family.

Spiderlings: Young spiders.

Stage: One of the periods in the life of a small creature; for example, egg, larva, nymph, pupa, or adult.

Taxonomists: The scientists who classify plants and animals.

Taxonomy: The science of classification.

Vertebrates: Animals having a backbone. Examples of vertebrates are fish, birds, reptiles, amphibians, and mammals.

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FURTHER READING FOR STUDENTS

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The perfect handbook to help students "collect, observe and raise their own bugs." How to organize a bug club, "bug tools", and bug exhibits.

Conklin, Gladys. *How insects grow.* New York: Holiday House, 1969.

Insect development in its three basic forms is presented by the author. A good companion to *The bug club book* . . . by the same author.

Davis, Bette J. *Musical insects.* New York: Lothrop, Lee and Shepard, 1971.

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An exploration of the secret world found beneath a rock that is worth reading despite a lack of pictures or diagrams.

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A detailed portrait in words and pictures of the praying mantis.

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A wealth of information on spiders, including legends, mythology, and experiments. Excellent black and white photographs.

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A factual account of the life cycles of insects found around fresh water.

McDermott, Gerald. *Anansi the spider: a tale from the Ashanti.* New York: Holt, Rinehart and Winston, 1972.

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Six of our insect friends are given an in-depth treatment. Beautiful yet accurate illustrations accompany the text.

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A delightful fantasy for adults and children, Charlotte, an intelligent spider, involves herself in saving Wilbur, the pig, from slaughter. Her own death is the end result.

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10 min sd. col. 16 mm

An award-winning film version of the book listed under *Further Reading for Students.*

Collecting insects and other small animals. (Filmstrip) Encyclopaedia Britannica, 1967.
5 rolls. col.

This series deals with the collection and preservation of insects, spiders, and microscopic animals.

How insects find a place to live. (Filmstrip) Encyclopaedia Britannica, 1968.
41 fr. col.

The ways and means through which insects find city homes under rocks, in plants, and in homes are explored.

How insects live and grow. (Filmstrip) Society for Visual Education, 1963.
51 fr. col.
A study of the life cycle and the growth of insects with detailed photographs.

Insects that help us. (Motion Picture) Film Associates, 1965.
11 min sd. col. 16 mm
Insects that help man in various ways are focused upon in this film.

Investigating insects. (Kit) Coronet Films, 1972.
6 filmstrips, 3 phonodisc, guide.
An informative study of both common and lesser-known insects, accompanied by excellent photographs and diagrams.

Spiders: backyard science. (Motion Picture) Film Associates, 1968.
11 min sd. col. 16 mm
An elementary introduction to the spider, showing how the spider functions and how it helps man by eating insects.

TEACHERS' GUIDE TO FURTHER READING

Costello, David F. *The world of the ant*. Philadelphia: J. B. Lippincott, 1968.
A thorough treatment of the ant world. The seasonal habits of the ant, social customs, homes, and enemies are a few of the items covered.

Fanning, Eleanor Ivanye. *Insects from close up*. New York: Thomas Y. Crowell, 1965.
The focus is on insects living in our own backyards. Delightful photographs, numbering more than 100, form the backbone of this book. The accompanying text is factual and easy to understand.

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Bibliography prepared by Evelyn L. Olejnik.

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